THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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LIGHTNING.

THIS period of the year is generally associated with the beginning of summer, the time not only of the swallows, but also of thunder and lightning, the destructive effects of which have this week been again demonstrated. The Report of the Lightning Research Committee, just published, is thus very opportune. The Report referred to* is an interesting and entertaining document, and is prefaced by a note from the pen of Sir Oliver Lodge, who is, perhaps, the greatest authority we have on the nature and effects of lightning flash. Sir Oliver reminds us that, since the code of rules for the erection of lightning conductors was issued in 1882 by the Lightning Rod Conference, there has been a considerable increase in knowledge of the subject. At that time the effect of self-induction was completely ignored, and electricity was treated as if it had no inertia, and would always take the easiest path from the clouds to earth. Lightning rod experts worked upon the assumption that they had to deal simply with a quantity of electricity, whereas to-day it is recognised that not only is it quantity that has to be discharged, but electrical energy.

It is pointed out that a sudden dissipation of energy is necessarily violent, and that, just as no one in his senses would attempt to stop suddenly a fly-wheel or a railway train, so it is scientifically incorrect to attempt to protect a building from lightning by providing a conductor of perfect conductivity. Such a conductor, if struck, would deal with the energy in so rapid and sudden a manner that the equivalent of an explosion would be the result. It is advisable, therefore, that lightning conductors should have a moderately high resistance so as to dissipate the energy slowly, quietly, and, consequently, safely. Even when this is done, the discharge is in the nature of a rush, and it is essential, therefore, that the path provided should be as straight as possible, or the lightning flash will tend to leave the conductor and make a path of its own.

Sir Oliver Lodge proceeds to say that the only way to protect a building absolutely is to enclose it entirely in metal—a statement somewhat at variance with the "moderately high resistance" theory—but, failing this, "an invisible cage or framework of iron wires, descending vertically down its salient features, suffices for all practical purposes."

The effect of "points" and of rain in dissipating an electrical charge has been long recognised, but we are reminded that when the energy is stored between cloud and cloud instead of between cloud and earth, "points" on a building are wholly inoperative. If a flash takes place between one cloud and another, the lower cloud is liable to overflow, and a violent discharge take place to earth, notwithstanding the provision of points in the neighbourhood. Such unprepared-for sudden flashes, in air previously unstrained, have been

* Report of Lightning Research Committee. Royal Institution of British Architects. 1s.

called B sparks, which occur as the secondary result of A sparks between two electrified clouds or other bodies.

This is one of the points of novelty in the present report.

The other, as previously mentioned, is the effect of electrical inertia or momentum, by which we are to understand that a discharge is not analogous to a leak or flow in one direction, but is more like an explosion or splash occurring in all directions at once, with little regard to the path which has been constructed for it.

Looking at it, then, from this point of view, when we have provided what is considered to be the best possible form of protection, apart from a complete metallic screen, there is still the possibility of part of the flash splashing out, so to speak, from the conductor, and following an unauthorised route of its own seeking to earth.

In the analysis of selected reports of buildings struck by lightning, following the report proper, there are a good many instances of damage caused by these side splashes. Thus, in the case of Stoerhead Lighthouse (Ref. No. 54), although the lighthouse was provided with a copper rod about $\frac{3}{4}$ in. in diameter, part of the flash took a path through the speaking tube and telephone wires, and also by a bedstead, setting fire to woodwork, burning out the telephone wires and doing other damage.

The Inverness Post Office (Ref. No. 78) was provided with a conductor of $\frac{7}{16}$-in. stranded copper, extending 12 ft. above the roof and terminating in sharp points at the top, and soldered at the bottom to a 12-in. iron water main pipe, which it encircled several times. Part of the flash left the conductor, passed along some gutta-percha-covered wires, which were ignited, and set the wood linings of the room on fire.

At St. Paul's Church, Bedford (Ref. No. 88) a conductor was provided, consisting of $\frac{5}{8}$ in. copper cable. When this building was struck, part of the flash left the conductor and splashed over to the lead flat at the bottom of the spire, and then divided, a portion of the discharge running to earth through rain-water pipes, which were broken as a result. The lead flashings on the roof were also broken and torn away, and, in addition to other damage, the main switch of the electric lighting system was fused.

Besides the above examples, there are a good many cases of telegraph instruments being damaged, principally in signal cabins, due to the overhead telegraph wires being struck. We have noted these particular cases in order to emphasise specially the necessity of studying the effects of lightning flash on electric wires and cables. So far, overhead construction in this country is confined chiefly to telephone, telegraph and trolley wires; but the time is probably not far distant when high-tension power mains will be run overhead, and, as these will be connected with transformers and motors on consumers' premises, precautions will have to be taken to minimise the chance of shock or fire arising from discharges entering the building from outside wires.

There is, moreover, the further consideration as to the possible effects of lightning on underground mains. When a building containing electric lighting, telephone, or power wires is struck, a portion of the discharge generally finds its way into the wires, as is evidenced in the above examples by the burning out of wires, electric switches, &c. The question arises then as to whether or not this is the full extent of the damage that is done. Is it not possible that when the wires of an electric light or power installation are struck, a portion of the charge, at any rate, may find its way to earth through the dielectric of the underground cables from which the installation is fed? If this be the case, the dielectric will probably suffer. It may even be punctured by a spark from the conductor to the metallic sheathing. It has often been a matter of great difficulty to account for the breakdown of underground cables, and it may be still more difficult to show that the breakdowns have resulted in part from electrical disturbances due to atmospheric conditions; but it seems highly probable. If we were not dealing with circuits having plenty of power behind them then it would not be a difficult matter to provide in surface boxes, suitable means for conducting any static discharge to earth. As it is, the matter is one which is perhaps not easy of solution, but is, we think, worth consideration.

Judging from the appendix to the report, giving the latest practice abroad, we gather that experience shows that the lightning conductor practice of the past has not afforded that protection which was anticipated. The view that absolute security was afforded by the largest possible cross-section of rod and by good earth connection, has not been borne out by experience, nor does it appear that the theory that a certain area was protected by a conductor of a certain height was of any practical value.

Our remarks of a few weeks ago, that under certain conditions lightning conductors might even themselves give rise to danger, are, we think, fully borne out by the report. This view was confirmed by Mr. Hedges, the honorary secretary to the Lightning Research Committee, in his presentation of the report to the Society of Arts on May 24th, when he said:—"*Still we see conductors erected in a manner which can be shown to be a source of danger, instead of acting as safeguards to the buildings.*"

The report concerning America reflects a very concise summary of American character. One would have thought that with the very tall buildings prevailing in American towns some special form of lightning protection would have been adopted, but, according to the report, there is a pretty general idea that lightning rods are not of very much use, and they have been largely dropped out of architects' specifications. But the buildings are insured against loss from this cause, and although several deaths have occurred from direct lightning stroke, and from falling masonry, little or no notice is taken of these events. The chief concern is to see that the loss is covered by insurance.

Embodied in the report are the rules relating to the erection of lightning conductors as issued in 1882, with certain observations by the Lightning Research Committee, 1905. Among the latter we learn that it is not considered necessary to go to the expense of gilding, platinising, or electro-plating the terminals of the conductors, and that it is desirable to have three or more points besides the upper terminal.

As regards the fixing of the rods, it is now recommended that these be carried at a certain distance away from the wall instead of being held by holdfasts. Referring to factory chimneys, two rods are recommended, and it is an advantage to have a band round the top of the chimney with rods curved into an arch above, provided with three or four points.

Where there is much ornamental ironwork on the ridges of the building, it is not sufficient to run a single vertical rod, but each end of the ridging should be connected to earth by a rod. All joints should be held together mechanically, as well as electrically, and should be protected from the atmosphere.

As regards churches, it is advisable to connect the church bells and turret clocks with the conductors.

As to the earth connection, it appears that the use of cinders or coke is not advisable, owing to the chemical or electrolytic effect on copper or iron. It is better to use charcoal or pulverised carbon, such as the ends of arc lamp carbons.

These are among the principal novel suggestions in the Report, but we should advise all interested in the subject of lightning protection to procure a copy of the document itself, as it is full of instructive matter which does not admit of abridgement without impairing its value.

Electrical Imports of India.

In neither of two recently published blue books, the one entitled a "Review of the Trade of India in 1903-4," and the other "Tables Relating to the Trade of British India," is any separate reference given to electrical wares or machinery. A reference to recent issues of the ELECTRICAL REVIEW will show the importance of this market to the British manufacturer of electrical goods. Surely the Indian Government might provide a separate classification for electrical apparatus and machinery, instead of lumping these under "machinery and millwork," as is now the case. It is really necessary that Government returns of import and export trade should distinguish the values coming from, or going to, various countries, directly a trade becomes of sufficient importance. Consideration of the fact that imports of corks to the value of £8,646 receive separate enumeration as to country of origin, and that electrical goods to 12 times this value do not, suggests that a thirst which Mr. Kipling considers peculiar to the East of Suez, is a more attractive statistical subject than electric lamps, generating sets, or tramway motors.

The Liabilities of a Tramway Company.

In an accident case which came before Mr. Justice Bucknill and a common jury recently, a point of some complexity arose as to who was to be held liable for a street accident. A contractor was making a manhole for the Ealing Borough Council in the Uxbridge Road, between the rails of the tramway which is worked by the London United Tramways Co. The contractor's men on leaving work left the hole open, and a youth who was riding a bicycle behind a tramcar, fell into the hole and was injured. Against whom was he entitled to prefer a claim for damages? He did what was most natural in the circumstances—he sued the contractor, for it was the contractor, or his workmen, who had made the hole in the road. At the hearing of the action it was contended that the London United Tramways Co. were responsible, inasmuch as the duty of shoring up any part of the roadway which is under their control was imposed by statute upon the company. Mr. Justice Bucknill, however, decided that even if the statute in question had this effect, it did not absolve the contractor from the duty of protecting the public. He, therefore, gave judgement for the plaintiff—the jury having found a verdict for £200 damages.

It may be of interest to refer to the statute which is said to cast liability upon the Tramway Co. The Tramways Act, 1870, which is incorporated with the London United Tramways Co.'s Act, provides, by Sec. 32, that nothing in the Act shall take away the power of any local or road authority to open up roads, and that, whenever for the purpose of enabling them to execute such work, the local authority shall so require, the promoters or lessees shall either stop traffic on the tramway to which the notice shall refer, where it would otherwise interfere with such work, or shore up and secure the work at their own risk and cost during the execution of the work there. Provided that such work shall always be completed by the local or the road authority, as the case may be, with all reasonable expedition.

In the case under review the contractor had given notice of the intended operations to the tramway company, who sent down a flag man to warn the public of their danger, but did not apparently take any steps to shore up the hole when the men had ceased work.

Upon reading the enactment above set out, it appears to be a somewhat daring proposition to assert that by merely serving a notice upon the tramway company a local authority, or their contractor, may transfer the whole responsibility of protecting the public to the company. Of course, it may be argued that the company may elect to stop their traffic altogether; and it is true that if in this case the tram traffic had been suspended, it would have been possible to erect a barrier to prevent any person passing over the place where the hole had been excavated.

The Iron and Steel Institute Address.

Mr. R. A. HADFIELD'S recent presidential address to the Iron and Steel Institute is now available in permanent form, and it is well worth study by a far wider circle of metallurgists and engineers than the audience to which it was originally delivered, for a more interesting and instructive presidential address we seldom have heard. Proud as is the position the Institute holds amongst our scientific societies—there is only one Iron and Steel Institute in the whole world—it may still be legitimately congratulated on having secured as its President for 1905 so able and distinguished a representative of the great Sheffield steel industry as Mr. Hadfield.

Opening with a brief account of the early history of the metallurgy of iron, Mr. Hadfield devoted some little time to the consideration of the work of scientific societies in general, and of the Iron and Steel Institute in particular, and he paid a generous tribute to the technical Press "for the wonderful work they do in keeping us supplied with the most recent information."

The bulk of the address consisted of a comprehensive survey of the present state and the future possibilities of the great industries for which the iron and steel metallurgist is responsible. One stands amazed before the stupendous dimensions these industries have now attained. The President estimates that the value of the world's production of iron and steel in their finished form is no less than £600,000,000, of which the United Kingdom contributes £160,000,000 and the United States £360,000,000. —a proportion which Mr. Hadfield, at any rate, does not view with alarm. These figures are likely to be enormously increased in the near future as the nations of the East develop needs for iron and steel. The present world's output of pig-iron is now over 50 million tons annually, but if the whole population of the globe (some 1,500 millions) were to consume as much iron per head as the inhabitants of the western world now use, the output would increase at once to 300 million tons, and even if only the present rate of increase continues, the consumption in the year 1950 will probably reach 100 million tons. Will the supplies of the world stand these colossal and ever-increasing strains on their not unlimited resources? Mr. Hadfield's answer is that such a rate of increase would quickly exhaust all the present known supplies of the world. But here we may, perhaps, be permitted to leave, for a moment, the solid ground of scientific inquiry and enter the region of speculation. The preponderance of iron in nature has led Arrhenius to infer that half this planet should consist of iron, the outer crust being composed of only from 4 to 5 per cent. of the metal. If this theory should prove correct, our supplies of iron ore will suffice for countless generations, but Mr. Hadfield wisely prefers to ignore speculative possibilities, and taking the facts to be simply as we know them, he warns the metallurgist to practise every possible economy in the manufacture and use of the precious metal. The scientific metallurgist, the man who, by his intimate knowledge of the structure and properties of steel, will, by and by, be able to make 1 lb. of iron go as far as 2 lb. do now, he alone is capable of effecting these desirable, these necessary, economies, and on his work, therefore—and this is in effect the burden of Mr. Hadfield's message—must to a large extent depend the future of our material civilisation.

NEW CABLE DRUM CARRIAGE.

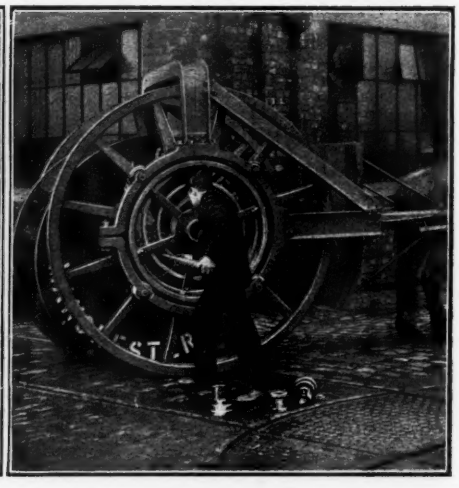
It is somewhat of a platitude that there is still unlimited scope for the exercise of ingenuity in connection with even the most ordinary pieces of mechanism; nevertheless, one cannot help sometimes feeling not only admiration but also surprise when suddenly confronted with a more than usually clever idea.

It is more than 2,000 years since Archimedes invented the screw for the purpose of raising water, his idea, suitably modified, but essentially the same in principle, has now been seized upon by some genius for the purpose of raising or lowering heavy cable drums with the utmost ease. The accompanying illustrations show the apparatus and various stages in the process of loading and laying, incidentally showing also that Messrs. W. T. Glover & Co., Ltd., are the proud possessors and manufacturers of the carriages.

As will be seen, each wheel runs in knife-edge wheel bearings, and is provided with an internal steel scroll, fixed to and revolving with the wheel. In using the carriage, it is first backed up to the drum, and an axle bar is passed through the drum and the two scrolls. When the horse is started, the revolving scrolls lift the drum gradually into its correct position at the centre of the wheels, where it is locked by means of the caps shown. To lower the drum, it is only necessary to remove these caps and back the horse, reversing the action of the scrolls. Nothing could be simpler!

Messrs. Glover have frequently been put to considerable expense through having to send men long distances merely to mount their cable drums upon carriages or lorries. Now, however, *one* man—and a horse—can handle the heaviest drums. The carriage shown in the views is somewhat needlessly heavy, and a lighter pattern is now being made, from which equally satisfactory results are anticipated. Cable men are to be congratulated upon this excellent solution of a long-standing difficulty.

Glover's Carriage about to Lift a Cable Drum.

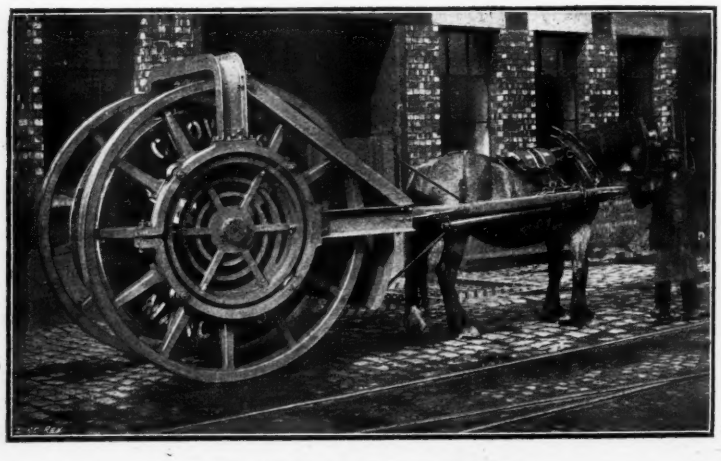


Inserting the Axle Bar.

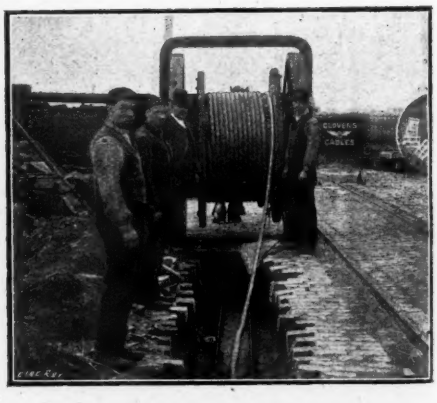
ELECTRIC LOCOMOTIVE FOR SWEDISH STATE RAILWAYS.

The illustration on the opposite page shows a single-phase electric locomotive supplied by the British Westinghouse Electric and Manufacturing Co. for the Swedish Government. One of the interesting features is the high trolley voltage for which the equipment is designed—18,000 volts—though connections are supplied for operating at several voltages lower than this, the minimum being 3,000 volts. This high voltage necessitates the use of an oil-cooled main auto-transformer and an oil-break circuit-breaker, oil having insulating properties which have been amply demonstrated by service in high-tension transmission. The intention is to experiment at various line pressures, with a view to ascertaining the highest working pressure suitable for the conditions prevailing upon the Swedish State Railways.

The control system is electro-pneumatic, and consists of an air compressor driven by a single-phase alternating current motor, an air motor on the induction regulator, air cylinders on the circuit-breaker and reverser, and the necessary magnet valves. The air brakes and air sanders are also to be supplied by the above compressor. There are two



Drum Lifted and Locked in Place.

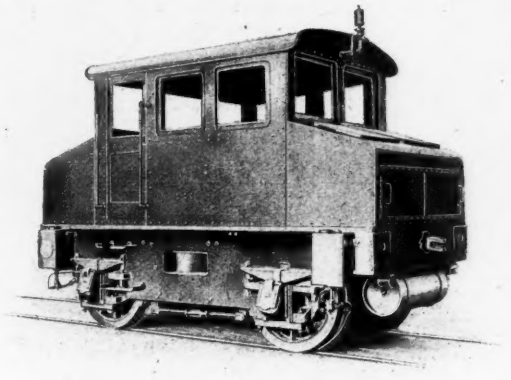


Laying Cable from the Drum.

connectors at each end of the locomotive, so that two locomotives can be coupled together and operated by one master switch. The latter is in the middle of the cab, and is so situated that the operator has a clear view in all directions without leaving his seat.

The weight of the locomotive and equipment is 25 tons, all of which is on four 41-in. driving wheels. Two 150-H.P., 25-period single-phase motors are geared, one to each axle, with a gear reduction of 18 to 70, and have proved capable of handling a 70-ton train at 40 miles per hour, without exceeding the rise of temperature for which they were designed.

The equipment has been so installed on the locomotive as to permit ready access to all parts. Only the small operating



Westinghouse Single Phase Locomotive.

devices have been placed in the cab, and the lay-out is such as to allow of the greatest convenience in operation with a maximum of safety to the operator.

The illustration shows the locomotive as sent out from the makers' works, and it should be noted that the buffers and collecting device, &c., are being fitted at the railway shops in Stockholm.

This locomotive has been built to the requirements of Mr. Robert Dahlander, Director of the Electrical Department of the Swedish State Railways, who is about to carry out a most interesting series of experiments upon the application of electric power for main line railway service.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Refuse Destructors.

All engineers who have had anything to do with destructor tests know that these should be taken with a very large pinch of salt, I suppose I must add "as a rule." These tests are not, however, published for engineers, but in order to impress the councillors who are considering a destructor for their town. One destructor firm, not very long ago, burnt refuse at a very low figure in wages per ton destroyed. I cannot give the figure, as to do that would be to name the firm. The engineer put in charge of this plant wisely failed to continue destroying at this figure, and all would have gone well with the destructor had not the attention of his committee been drawn to the test. Of course, after this, the engineer was asked "Why he could not burn refuse at the test figure?" and he was badgered until, in desperation, he sacked every good man in the place, putting in their stead half the number of half-starved loafers, these men he overworked and underpaid, the refuse accumulated, the place became filthy dirty, the loafers struck and the plan failed! This was not all, for the hired and unskilled labour had damaged the brickwork to such an extent that heavy repairs were necessary at the end of the first year! The test, which caused all this subsequent trouble and worry to the engineer and expense to his council, was carried out in the following way:—Certain labourers, say at 6d. per hour, were worked for this one test under the maker's expert fireman; this fireman looked after everything and the labourers had nothing to do but clinker out and charge under his direction. These labourers were promised (not by the firm, of course, but by their fireman!) 10s. 6d. each at the end of the test if it was good. It can be imagined how the men slaved for these few hours! I need hardly say that neither the wages of the expert fireman nor the gratuity to the labourers nor the "refreshment" which the latter consumed, were counted in the "wages cost per ton destroyed." The unfortunate manager's troubles, it will be seen, were very real, when he was trying to work to this figure!!!

Every maker—but alas! not every man on the town council—knows that a destructor which is used for nothing but destroying refuse can be worked more economically than one combined with an electricity works. Some of the reasons are as follows:—

1. In the former case the clinker is of a far better quality and commands a ready sale, in the latter case it has been found in practice to be impossible to have both steady steam and good hard clinker.

2. Refuse can be burnt steadily, the brickwork kept at an even temperature, and with few men in the former case, in the latter the cry is for steam, and steady steam. The cells are forced on the "peak" and cooled down on the battery load. This makes the maintenance and wages of a destructor, combined with electric light plant, a very serious consideration, while in a destructor alone these items are insignificant.

Some makers, however, trade on these facts, for they make out two sets of results, the first set shows the economy of working and the small maintenance cost of their destructor, but says nothing about steam raising results. This set I need hardly add has been taken from destructors pure and simple. The record set is full of "120 units per ton of refuse, and even more" kind of talk, but wages and maintenance are not mentioned. These two sets are sent to Mr. Smith, J.P., butcher and town councillor, who, with the remarkable engineering intelligence common to his class, sees at a glance that "So-and-so's destructors are cheap to work, cost a trifle to keep up, and turn all the refuse into steam, enough to light our town." In other words, Mr. Smith is "had," and so are all the rest of the know-all-about-destructor-deputation-councillors!

In spite of all that has been said and written, the destructor is the better for being by itself, and can be worked and do its proper work—burning refuse—far better and more cheaply. Electricity works should not be less than 1 mile from a destructor, and nothing has yet been *proved* to the contrary, especially in our larger towns where the electricity works outgrow the destructor, and the latter is then only a nuisance and drag to the former. As a further support to the above statement, it may be noticed that where coal is costly the calorific value of the refuse is very poor, and where the refuse is good for steam raising, coal is cheap! Where is the combined refuse destructor and electricity works which is an unqualified success, not only to the man in the street but to the man who really knows *all* the facts about it? These facts are hard to learn, as the engineer naturally tells deputations the truth, but not the whole truth—and the maker's representative also tells the truth—and other things!

Cell.

Electrical Power for London.

We are all so busy trying to destroy each other, that any suggestion for mutual aid will seem pretty mad. Nevertheless, I venture to make a suggestion with regard to electrical power for London.

I would have an electric power exchange regulated by a Government official. Each existing undertaker should have the right to connect to the exchange at his own expense, and would bear his fair share of the cost of the exchange. All the undertakers belonging to the exchange would state the amount of power which they would be able to give or take, and the times at which the supply could be given or taken, and the rates at which it would be given or taken. It would be open to the official in charge of the exchange to accept such offers as he would deem best, and a penalty would be incurred by anyone failing to perform an accepted offer.

E

The advantages of such a scheme are almost too obvious to need stating, and the disadvantages would be more temporary than permanent.

To add new undertakings in London is to make chaos more chaotic, whereas the State-regulated exchange, if anyone will take the trouble to think about it carefully, would provide in time all the advantages of a comprehensive scheme at the lowest capital cost, and without interfering with the business of existing undertakers.

Railways, tramways and canals could connect to the exchange, and would have all the London generating stations at their backs.

I will not trespass further on your space, though it would be easy to enlarge on this subject.

A. E. Voysey.

Public Health Department,
Guildhall, E.C.
May 24th, 1905.

Charging for Supply.

With reference to your question in the "Correspondence" column under "Inquirer," I beg to say that I took this matter up in Birmingham some few years back, and could not get the whole of the consumers' different accounts for separate premises treated as one, although they were owned, without question, by one man.

I suppose the ruling depends entirely on the local authority, as to whether they will guarantee what seems obviously fair, or not, as the case may be.

Cecil D. Falcke.

Birmingham, *May 26th*, 1905.

Power Station Economies.

I notice in your issue of the 26th inst. a letter from a person who signs himself "Station Engineer," with reference to a paper I read at Birmingham. If the gentleman will let me know his name I shall be very pleased to answer the letter through your paper.

It is not my habit to take cognizance of any anonymous communication, but I feel sure that a paper of your standing would not have published a letter containing the innuendos which this letter does, unless there was some good grounds for doing so, more especially in view of the fact that you yourselves had a copy of the paper, and know of course that the statements contained in the said letter are not a true criticism of the paper in question.

Jos. A. Jeckell,
Manager.

Corporation Electricity Works,
Coventry, *May 29th*, 1905.

New Regulations for Electricity in Mines.

We have overcome our natural impulse to leave unanswered a communication expressed in such terms as that of Mr. Nalder in your issue of the 26th, and we beg your permission to reply to it *seriatim*. That letter consists of four sentences, in which are embodied what we can only describe as three positive mis-statements.

In the first place, he accuses us of a "wanton" and "impertinent" attack upon his firm. We, and others well competent to judge, have carefully scrutinised our letter of the 8th, and have failed to discover the remotest semblance of an "attack" of any sort. It is hardly necessary to say that we should not dream of using your columns for the purpose of attacking a firm for which we have, hitherto, entertained the greatest possible respect; nor would you, Sir, permit it if we did. In the course of our inquiry into this matter, we put ourselves to the trouble of cutting out our respective communications and placing them side by side, and then, indeed, a most unwarranted and unjustifiable attack was certainly apparent, but it was not contained in our letter.

Then, it is stated that in reply to the application to us for particulars of the arrangements we had developed for meeting the requirements of the Home Office, we confined ourselves to furnishing price lists. The actual fact is that we sent two pages of descriptive matter (between 450 and 500 words) and, as it happens, quite as an afterthought, a third sheet giving prices. In passing, we note that Mr. Nalder succeeded in restraining his indignation at our wanton and impertinent attack until the details of our arrngements were in his hands, although he had an opportunity of resenting it in your issue of the 19th. Can it be that he expected calcutions and working drawings?

We are young, of course, but not so young as that.

Thirdly, it is implied, and the implication is so strong as almost to amount to an assertion, that the apparatus described by us does not fulfil the requirements of the Home Office. We are especially distressed at this, as it compels us, in self-defence, to do violence to our native modesty to the extent of making an extract from a letter, entirely spontaneous and unsolicited, which we received a fortnight ago from a Manchester firm whose name is a household word:—"We are very much obliged for yours . . . . replying to ours . . . inquiring for instruments to comply with the new Home Office Mining regulations, and must congratulate you upon the efficient manner in which you have dealt with the problem at issue. We think you will be interested to know that your quotation is decidedly the most satisfactory, not only as regards price but also as regards your offering a suitable appliance, which we have received, although we inquired from three other leading instrument makers." Whether the exact wording of the Home Office regulations may leave something to be desired seems to us to be beside the point. The spirit of the regulations is excellent, and with that spirit, we are assured, our instruments fully comply. We had taken the matter up with the authorities some time before Mr. Harris's letter appeared.

We can take no possible exception to the remaining sentence in Mr. Nalder's letter, in which he states that he does not propose to enter into a correspondence with us on the matter. We heartily applaud this decision, and can only regret that he did not come to it before permitting himself to make use of the offensive expressions towards us which now disfigure your columns. We deplore the necessity which has been forced upon us of continuing this correspondence. Such disputes, engendering ill-feeling between business firms, are exceedingly mischievous, and we would suggest that the cultivation of a sense of humour will go a long way towards avoiding them. Failing this, another way, as Mrs. Beeton says, is to sleep on a hasty letter.

Everett, Edgcumbe & Co.

London, S.W., *May 30th*, 1905.

Gas Engine Working.

I should be pleased to learn through the medium of the ELECTRICAL REVIEW as to the experience and results of the working of the Westinghouse gas engine (using town gas), say, up to 100 B.H.P., for direct-driven generators in continuous-current central stations, or even a large private plant using such. My experience is not by any means encouraging.

Back Fire.

Price Lists.

As regards Mr. Hazell's letter a week ago, under the above head, the idea of standardising is certainly a great consideration towards solving the question of reducing the cost of these useful books, also for keeping the bookshelves tidier; but you must take into calculation the fact that a busy man has not the time to wade through a set uniform in size, which would be the case if this proposal became an accomplished fact. Seeing buyers as I do day by day, my impression is that the more unlike one is to the other, and having a mental note of the catalogue required, the rest is plain sailing.

R. Belcher.

Birmingham, *May 30th*, 1905.

Localisation of Faults in Cables.

The interest taken in the recent correspondence in the ELECTRICAL REVIEW on fault-locating tests, is certainly a good sign, as it shows that this important subject, although not valued at its true worth, is receiving some attention, and it is only by an interchange of opinions by those who are actually meeting and overcoming the various difficulties that solutions of any value can be obtained. Several correspondents referred to the "Bergh" test described by me some time ago in the *Electrical Magazine*; one writer even went so far as to question the origin of the test then described. I would, with your permission, like to state that this test was devised by Mr. Bergh over two years ago, to overcome certain shortcomings of all other known tests. It is to be commended for its simplicity, accuracy and quickness in application. It can be adapted to every conceivable kind of fault, and has been effective on a cable with two faults about 100 yards apart, in this case locating the largest first. I may here say, *en passant*, that this test has been successfully applied on a large network—and certainly one of the oldest—for over two years on both triple-concentric and single cables, ranging in size from 1 sq. in. to single arc lamp mains. There has been ample scope to prove the efficiency or otherwise of the test, and during the whole of that time it has never been found necessary to open consumers' switches or remove their fuses, as some of your correspondents seem to think.

"B. S. H.," writing in the ELECTRICAL REVIEW, April 14th, 1905, says: ". . . . I say it is absolutely imperative (if the test is to be a success) to draw consumers' main fuses or open their main switches, &c." In reply to "B. S. H.," I would ask him to apply the test *as described*, and give us the benefit of his experience, as then his opinion will have some weight.

"Weary Willie and Tired Tim," writing in the REVIEW, April 21st, 1905, says: ". . . . In these articles it is stated that the tests can be applied without access to consumers' premises, ... but *we* quite fail to understand how the test can be applied, &c., without opening consumers' switches." My request to "B. S. H." also applies to "Willie" and "Tim," but I do hope they will not apply the test until they do *quite* understand it. On May 5th the "Weary" and "Tired" couple make a very strong point (for them), they say that "four out of the six tests given in the *Electrical Magazine* were made between the hours of 10 a.m. and 3 p.m." I would here explain that these tests were given as an example, because they were consecutive and the most recent, and I entirely fail to see how this fact can be adduced against the efficiency of the test. On the other hand, I am sure that all engineers with experience on large networks will agree with me, that this is an ideal time for taking off faults, when the conditions are favourable. "Willie" and "Tim" were evidently more keen on finding evidence against, rather than for, the test, or they might have observed that these tests were made in the middle of August, one of the lightest months of the year, and at a time when least light would be required, so that as far as lighting consumers were concerned little or no inconvenience would be felt. With regard to power consumers, as a meal-hour generally intervenes between 10 a.m. and 3 p.m., it is a very easy matter to arrange to take test during that time. Of course, all details of this sort must be considered on the spot, and are not worth discussing here.

I repeat all that I said in my previous articles in favour of the test, as my experience since has more than confirmed what I then said; and as no one among your numerous correspondents has suggested any other method in preference to the "Bergh" test, it appears to me that the latter is all I have claimed for it, and ranks well in front of all others.

In conclusion, I would add that the testing set is well adapted for its work, and the saving of time alone very soon pays for its cost, apart from the great saving effected in reinstatement; and this latter, in these days of wood block, asphalte and other costly paving, cannot be ignored, as it may cost anything from 10s. to £1 per yard. Great care must be exercised in measuring the length of the cable, as it is here that the real difficulty presents itself. It is almost impossible to allow accurately for deviations due to pipes and other obstructions; but, even allowing for slight errors in measurement, the fault is generally found within the length of the necessary joint-hole. My only excuse for trespassing on your valuable space is to emphasise that the test can be applied in a few minutes *without* access to consumers' premises, and is reliable.

James Cleary.

Brighton, *May 29th*, 1905.

THE OPTICAL CONVENTION.

THE opening of the above convention at the Northampton Institute on Tuesday last, by Dr. R. T. Glazebrook, emphasised the great importance of this branch of industry to the scientific and engineering worlds.

The object of the convention is to bring into closer touch the practical and scientific problems which affect the production of apparatus of an optical nature.

For the achievement of this, numerous papers dealing with optical subjects will be discussed during the week, and recourse will be had to the very extensive exhibits of apparatus which are on view in the hall of the institute.

To the latter, then, unfortunately, in a state of chaos, we were privileged visitors last Tuesday, and despite the lack of completeness, were much impressed by the extent and comprehensive character of the exhibits. To those for whom the convention has close interest the exhibition catalogue, a volume containing some 280 pages of descriptive and illustrated matter, will prove a most valuable book of reference, and to it we must refer our readers for a complete account of the exhibits, which include much of engineering interest.

Of more particularly electrical interest, we noted the exhibits of Mr. R. W. Paul, who had on view the Nernst-Paul high-power projector lamp, recently described in the ELECTRICAL REVIEW, optical arc lamps and electric lanterns of various patterns, and a recent model of Paul's "Reliance" animatograph; the Cambridge Scientific Instrument Co., Ltd., were exceptionally well represented, their exhibits including the Dolezalek electrometer, and a micro-electroscope designed especially for the investigation of radio-active phenomena, a spring galvanometer with which a current of 10^{-12} amperes is detectable, an example of Callendar's mechanical equivalent of heat apparatus and a great variety of photometric and laboratory appliances.

Messrs. John J. Griffin & Sons, Ltd., were also prominent with laboratory apparatus, their exhibits including Rubens's linear thermopile, an instrument in which fine iron and constantin wire couples replace the usual bismuth-antimony couples, the instrument being designed to give great sensitiveness. At this stand there was also shown an apparatus for the determination of relative conductivity of thin layers of materials (Lees' and Chorlton's method).

Messrs. R. and J. Beck, Ltd., had on view specimens of the original and recent types of Finsen apparatus, and also a photometer bench constructed for the National Physical Laboratory. The Edison & Swan United Electric Light Co., Ltd., showed specimens of the Fleming Ediswan standard photometric lamp, and Messrs. Everett, Edgcumbe & Co. were prominent with photometers and lamp-testing wattmeters and ammeters.

Messrs. Newton & Co. had on view an electric lantern microscope and micro-polariscope, and a triple rotating lantern of large size. Among the numerous exhibits of general interest, we can only indicate the more prominent; thus a very complete display was made of surveying instruments and of microscopic and photo-micrographic apparatus by all the well-known makers. Photographic apparatus, astronomical and nautical instruments, range-finding devices, telescopes, binoculars, and, in fact, every description of optical appliance devised to aid the human sight, down to tortoiseshell spectacles of Chinese origin and ancient Dutch barnacles, were on view.

Messrs. Chance Brothers, Ltd., of Birmingham, had a striking exhibit of lighthouse apparatus in the gallery, and a no less interesting one of optical glass in the main hall.

The convention will close on June 3rd.

The Evaporation of Metals in the Vacuum of the Cathode Light.—Continuing some work carried out two or three years ago by F. Krafft on the evaporation and boiling of metals in quartz glass, and in the electric furnace in the vacuum of the cathode light, Krafft and Bergfeld have now determined the lowest temperatures at which the metals evaporate. Using a tube of quartz, and working with the electric furnace, they have found the lowest temperatures to be:—For silver, 680° C.; for copper, 960°; and for gold, 1,070° C. In glass vessels, and when suitable organic liquids were employed as the sources of heat, other lowest temperatures were:—Cadmium, 156·6°; zinc, 184°; bismuth, 268°; lead, 335°; potassium, 90°; sodium, 140° C. The former research was described in the *Berichte*, 1903, XXXVI, 1,690.

PARLIAMENTARY.

LONDON ELECTRIC POWER BILLS.

Administrative County Scheme.

Tuesday, May 23rd.

THE Committee dealt with the clauses in this Bill. On Clause 48 as amended [which will be found in the report of Monday's proceedings; see ELECTRICAL REVIEW, page 844] the CHAIRMAN asked whether the clause would enable the Board of Trade to appoint an arbitrator to determine the question as to whether consent had been unreasonably withheld, or did it restrict the matter to the Board of Trade themselves.

Mr. LLOYD, K.C., said that in practice the Board of Trade did it themselves under the Board of Trade Arbitration Act.

The CHAIRMAN remarked that it threw a heavy burden on the Board of Trade.

Mr. KENNEDY: I understand that the Board of Trade do not object.

The CHAIRMAN: How do you know that? Have you asked them?

Mr. KENNEDY: Yes.

The CHAIRMAN: Well, a whisper reached me yesterday to the effect that they did object.

Mr. LLOYD pointed out that under the Board of Trade Arbitration Act the Board would have full power to appoint an arbitrator, and the clause would take no power as to that away from them. The clause was then agreed to.

Clause 48A, which will also be found in the report of Monday's proceedings, was next proceeded with.

The CHAIRMAN asked what would happen if the company did not comply with these requirements.

Mr. LLOYD said they had incorporated the general Acts under which the Board of Trade had power to revoke their powers.

Mr. MORTON (for th West Ham Corporation) said he thought if the work was not done within a certain time the powers should lapse.

Mr. LLOYD suggested the following words to follow Sub-sec. 5:—"If the company do not within the prescribed period comply with such requirements, the Board of Trade may order that the powers of the company to distribute energy within such area shall cease."

The CHAIRMAN intimated that this would be acceptable.

Mr. LLOYD said it had just struck him that by these words they might shut themselves out from supplying railways, &c., and he would like to safeguard the company in regard to this.

It was agreed that before the words "shall cease" the following should be inserted, "except to authorised undertakers, or to the proprietors or trustees of any railway, tramway or waterworks, or to any dock, canal, navigation lawfully entitled to use energy or to any Government department."

On Clause 57, which is the sliding scale clause, the CHAIRMAN said that the standard price fixed was 1d., and as it had been repeatedly urged that the company would be able to supply at ¾d., or even less, they would start with a dividend of 8 or 11 per cent. That was a very comforting dividend to start with.

Mr. LLOYD: We are so convinced of that, that if you make the suggestion that 1d. be struck out, and ¾d. be put in, we would be quite content.

The CHAIRMAN: We will take that.

The clause as amended was agreed to.

Mr. NIELD, for the other companies whose Bills have passed, objected to Clause 65, which allowed the company to enter into agreements with railways, canals, &c. It was contended that the company ought not to be allowed to supply to companies partly outside the area for other than traction or haulage purposes.

Mr. MERZ was called, and said the promoters looked upon this clause as of great importance. It would be no good going to a railway company and making an offer unless they could relieve the railway company from the trouble and responsibility of putting up a generating station to light their own stations, and so on.

Mr. NIELD pointed out that in the North Metropolitan and other companies' Bills, the words "haulage and traction" were not imposed by the Committee.

COUNSEL said they were agreed upon with the local authorities.

Mr. LLOYD said the other companies had made a grave mistake themselves, and now wanted to put them into a similar position. He wanted to avoid allowing his clients to fall into the same hole.

The Committee, after consultation, allowed the promoters the clause they asked for.

On Clause 66 which authorised agreements with contiguous authorised undertakers for supply of energy, it was agreed to add the following words: "Provided that the power conferred upon the company by this section shall not be exercised within the respective areas or districts of the Metropolitan Electric Supply Co., Ltd., and the North Metropolitan Electric Supply Co., Ltd., without the consent of the company affected."

The CHAIRMAN said that during the hearing it was said that Clause 69, which allowed the company to accept the transfers of electric lighting orders might lead to a monopoly.

Mr. LLOYD said the clause was not absolutely vital to his scheme.

No objection was offered to the clause and it was allowed.

The Committee passed Clause 75 with the following provision:—. . . . "Provided that this section shall not be deemed to exempt the generating stations and works of the companies from the operation of the Factories and Workshops Act of 1901."

Mr. FREEMAN, K.C., then brought up a new clause for the Metropolitan Water Board with respect to the protection of pipes from electrolysis.

Mr. C. H. WORDINGHAM was called, and spoke as to the effect of the leaking of current and the pitting of water pipes in consequence. He said that the matter had been discussed in many tramway Bills, and thought that the clause should be inserted in this Bill. He knew that the danger from alternating current was less than that from continous current, but added that with the high tension current which the promoters would use, the possibility of danger was increased.

Mr. LLOYD, on behalf of the promoters, called Mr. MERZ, who said there was really no danger from electrolysis. He objected to the clause, because it was unnecessary; it would be just as reasonable to insert a provision that the promoters should not pull down Westminster Abbey.

Mr. LLOYD, addressing the Committee, pointed out that the existing companies had no such clause in their Acts. If the clause were inserted, the promoters might be called upon to pay for damage done by the existing companies. As the law stood at present, the Board of Trade made special regulations in each case, and he contended that if such a clause were necessary, it should be made applicable to all the companies. The Committee inserted the clause.

Wednesday, May 24th.

On Wednesday Mr. Hutchinson, for the Kingston Gas Co., was granted a clause giving that company protection against electrolysis.

On Clause 3, which is to exempt the company from liability to nuisance caused by its generating station. Mr. MORTON, for West Ham) protested that the clause would place the promoters in a far better position than the Charing Cross Co., which also had a generating station in West Ham. On general grounds he maintained that it was unfair.

Mr. LLOYD, for the promoters, said that the clause was perfectly fair, inasmuch as Parliament had given the promoters special powers to take land for their generating station. Had the promoters been left to acquire land by agreement, then they would have been liable under ordinary law. The Committee passed the clause.

On Clause 5, which deals with the breaking up of streets, Mr. MORTON (West Ham) asked that compensation should be paid to West Ham for any damage done to their tramways.

Mr. LLOYD remarked that the matter was dealt with in the Electric Light Clauses Act.

The Committee disallowed Mr. Morton's objection.

THE AREA OF SUPPLY.

Clause 43, which deals with the area of supply, was then considered by the Committee, and it was decided that the area should be—

In the Administrative County of London.—The City of London, the City of Westminster (except those portions supplied by the Metropolitan Co.) and the Metropolitan Boroughs of Batterses, Chelsea and Wandsworth.

In the County of Surrey.—The County Borough of Croydon, the Municipal Boroughs of Kingston-upon-Thames and Richmond, the Urban Districts of Barnes, Carshalton, Ham, Sutton, The Maldens, and Coombe and Wimbledon, and so much of the Urban District of Surbiton as is comprised in the civil Parishes of Surbiton and Tolworth and of the rural district of Croydon as is comprised in the civil parishes of Beddington, Merton, Mitcham, Morden and Wallington.

In the County of Kent.—The Municipal Borough of Bromley and the Urban Districts of Beckenham and Penge. The Municipal Borough of Gravesend, the Urban Districts of Bexley, Chislehurst, Dartford, Erith, Foots Cray, and Northfleet, the Rural District of Dartford, and so much of the Rural District of Bromley as is comprised in the civil parishes of Mottingham, North Cray, Orpington, St. Mary Cray, and St. Paul's Cray.

In the County of Essex.—The County Borough of West Ham, the Municipal Borough of East Ham, the Urban Districts of Barking, Grays Thurrock, Ilford, Leyton, Romford, and so much of the Rural District of Ossett as is comprised in the civil parishes of Aveley, Bulpham, Chadwell, Little Thurrock, North Ockendon, South Ockendon, Ossett, Stetford and West Thurrock.

And the following boroughs (referred to as "the industrial portion of the area of supply,") in the Administrative County of London.—Bermondsey, Bethnal Green, Camberwell, Deptford, Finsbury, Greenwich, Hackney, Islington, Lambeth, Lewisham, Poplar, St. Pancras, Shoreditch, Southwark, Stepney and Woolwich.

The remaining clauses in the Bill were then passed by the Committee, and the Bill was ordered to proceed.

Metropolitan Electric Supply Co.'s Bill.

THE Committee then considered the clauses in this Bill.

Replying to the CHAIRMAN, Mr. CRIPPS (Parliamentary Agent) said that the powers of the company in the Bill were restricted to supply to authorised undertakers, with the exception of railways, tramways, &c.; it was not intended to supply to private persons.

The CHAIRMAN said that certainly in the original Bill power to supply private consumers was included.

Mr. CRIPPS said that it could not have been a filled up Bill.

The CHAIRMAN said they were now proposing to supply the district on terms quite different from those on which the Administrative Co. would supply, but when the Committee said that the Bill might proceed, it was certainly on the understanding that the terms of supply were identical.

Mr. RAM, K.C., said that the terms and conditions of supply would be identical in the two Bills. It was only in the industrial area that the Administrative County Co. was empowered to supply to manufacturers. In the non-industrial area both companies were restricted to supplying to authorised undertakers.

Mr. FREEMAN, K.C., called attention to Clause 3, which, he said, would enable the company to break up streets, railways and tram-

ways without the consent of the local authority or company concerned. On behalf of the various railway companies he asked for the insertion of a clause which would provide (1) That in laying down, maintaining and renewing cables, pipes, wires, &c., such works shall be executed at such times and in such manner as the engineer of the railway company might direct; (2) If any injury should arise from such works, &c, the company should be liable to make compensation to any railway company, the amount of such compensation, unless agreed upon, to be determined by arbitraton. (3) If the railway company at any time wishes to adapt its railways, or parts thereof, for working by electrical energy, or requires to alter or reconstruct bridges, tunnels, railways, &c., the railway company may, on giving 14 days' notice, or in case of emergency without notice, carry the apparatus, &c, of the Power Co. over their lands, &c., at any other point without being liable for any compensation in respect of such diversion, and should be entitled to compensation for the additional expense they were put to.

The Chairman asked why, if that clause had been accepted in the Administrative Bill, it should not be put in this Bill.

Mr. Ram said the Administrative Bill came for the first time, and got certain powers, and was subject to all new legislation. His, however, was an old company, and was subject to all the restrictive clauses of the different Electric Lighting Acts. He contended that the railway companies were amply protected under Clauses 15 and and 19 of the Electric Lighting Act of 1899 which were incorporated in his Bill. If Mr. Freeman was looking forward to future expenses which might be incurred by railway companies in moving mains, &c., of the Electric Co., he admitted that was not provided for, nor should such a burden be imposed on the company. They had been in relation with the railway companies in their area for years under the old Acts.

The Chairman said the question really was whether it was just that a railway company which was put to additional expense in moving the apparatus of the Power Co. should not get that additional cost from the same company.

Mr. Ram said if the Committee decided to give the clause, he would at all events ask that its operation should be limited to what occurred under this Act.

The clause was then passed by the Committee.

Mr. Ram submitted the following new Clause 4A, defining the area of supply in the County of Middlesex:—"Subject to the provisions of this Act and notwithstanding anything contained in any former Act, it shall be lawful for the company to sell and transmit electrical energy to authorised distributors within any part or parts of the district in the County of Middlesex comprising the following local areas, viz.:—The borough of Ealing and the Urban Districts of Acton, Hanwell, Southall-Norwood, Greenford, Uxbridge, Hayes, Chiswick, Brentford, Heston and Isleworth, Twickenham, Teddington, Hampton, Hampton Wick, Sunbury-on-Thames, Feltham, and Staines and the Rural Districts of Uxbridge and Staines. And to use all or any of their stations, lands, mains and apparatus for that purpose."

It was agreed to insert an electrolysis clause for the protection of the Brentford Gas Co.

Mr. Freeman submitted an addition to Clause 13 which provided that the company should not break up any of the subways which lead to the Central London Railway Co.'s stations without the consent of that company. The promoters agreed to insert this proviso in a different part of the Bill.

In accordance with an agreement arrived at with a number of local authorities, the following addition to Clause 13 was agreed to:—

"Provided also that any trenches or excavations made by the company for the purpose of laying mains, conduits, cables, wires, tubes, boxes, pipes and apparatus or repairing the same shall be filled in and made safe by the company within a reasonable time after the same shall have been opened for such purposes as aforesaid in a good and workmanlike manner and to the satisfaction of the surveyor for the time being of the respective local authorities and the permanent reinstatement of the same may be carried out by such local authorities who shall be entitled to recover the expenses incurred in respect thereof from the company as a civil debt. Provided also that the provisions of Sec. 14 of 'the Electric Lighting Act, 1882' shall apply to the exercise by the company of the powers conferred upon them by this Act."

Mr. Ram submitted a new Clause 15A for the protection of the Urban Districts of Brentford, Chiswick, Feltham, Heston, Staines, Teddington and Twickenham, with respect to the laying of cables, &c.

Mr. Monro moved a new clause to prohibit the company from acquiring electric lighting undertakings in any district without the consent of that local authority. He pointed out that it would be possible for the company to purchase the shares in an existing company and link up a big system which would prohibit the local authority purchasing when the time came.

Mr. Ram said if they did buy any company, they must purchase it under all the terms on which the order existed.

Mr. Monro said if the company bought a lighting company there was nothing to prevent them mixing the two concerns up.

The Chairman: Then they would have to unmix them when the time for purchase came.

Mr. Monro said the question was what the purchasing authority would have to purchase.

The Chairman said that would have to be gone into when the time came. The Committee disallowed the clause asked for.

Mr. Ram brought up the following new Clause 16A to carry out the finding of the Committee as to additional powers in London:—"It shall be lawful for the company, subject to the provisions of this Act, to sell and transmit electrical energy to authorised distributors who are authorised by Act of Parliament or provisional order confirmed by Parliament to give a general supply of energy within the following areas in the County of London or any part thereof:—The Metropolitan Borough of St. Marylebone; the Metropolitan Borough of Hampstead; the Metropolitan Borough of Hammersmith; the Metropolitan Borough of Kensington; the Metropolitan Borough of Fulham. Subject to the provisions of this Act, the company may for that purpose make use of any cables and wires already laid by them, or which they are authorised to lay, and of any of their lands, stations and works, and exercise all or any of their statutory powers for breaking up streets and laying cables and mains, and all the powers hereinbefore conferred by this Act for the supply of energy to authorised distributors in the County of Middlesex, shall apply and have effect for the purposes of enabling the company to supply energy to authorised distributors within the said Metropolitan Boroughs. Provided that, except with the consent of the authorised undertaker, nothing shall authorise the company to sell and supply electrical energy within the Boroughs of Hammersmith, Kensington and St. Marylebone, or to break up any street or lay any cable, &c., except with the consent of the authorised undertaker."

The Chairman said that they took power for supply in Hammersmith, but had apparently agreed not to supply.

Mr. Ram said that was so.

The Committee ordered the clause to stand part of the Bill.

The remaining clauses in the Bill, which were passed by the Committee, included the following:—

For the protection of the Metropolitan District Railway Co. and the Underground Electric Railways Co. of London, Ltd. (referred to as "the two companies"):—

1. The company shall not in the exercise of the powers contained in this Act lay, or place any cables, mains, pipes or other works within 3 ft. of the cable subway and line of cables (in this Section called "the Cable Subway") of the two companies situated in the Metropolitan Boroughs of Chelsea and Kensington, and leading from the Earl's Court Station on the Metropolitan District Railway to the generating station at Lot's Road, Chelsea;

2. In laying down, altering, improving, enlarging, extending, maintaining or renewing, or in executing or effecting the repairs or renewals of any cables, mains, pipes, or other works in exercise of the powers contained in this Act over, under, or within 10 ft. of the cable subway, the same shall be done under the superintendence, and to the reasonable satisfaction of the principal engineer of the two companies, and according to plans to be previously submitted to and reasonably approved by him in writing within one calendar month after such submission, or in case of difference as may be determined by arbitration in the manner hereinafter provided.

3. All such works as are referred to in the preceding Sub-section shall be done by, and at the expense of the company, who shall also restore and make good to the reasonable satisfaction of such engineer, the roads over the cable subway so far as the same may be disturbed or interfered with, by, or owing to any operations of the company: Provided always that should the two companies elect so to do they may themselves carry out the work of laying the same, and of restoring and making good the roadway at the costs, charges and expenses of the company;

4. All such works and operations and all matters incidental thereto shall be constructed, executed and done at such times and in such manner as the engineer of the two companies may direct, and so as to cause as little injury as may be to the cable subway so as under no circumstances to cause any interruption to the electric current in such cables;

5. If any injury or interruption as aforesaid shall arise from or in any way be attributable to any of the acts, works, operations and matters aforesaid, or to any default or omission of the company or their contractors or servants in exercising any of the powers of this Act, the company shall make compensation to the two companies in respect thereof, the amount of such compensation unless agreed upon to be determined by arbitration in the manner hereinafter provided;

6. If the two companies at any time or times hereafter require to construct any additional or other works in connection with, or to widen, alter, reconstruct or repair the cable subway over or under which any of the works of the company may have been constructed or laid, they may, on giving to the company 14 days' notice in writing, and in case of emergency (of which their engineer shall be the sole judge) without notice divert, alter, support or carry the said works of the company over or under the cable subway at any other point or otherwise deal with the same in as convenient a manner as circumstances will admit, and doing as little damage as may be without being liable to pay compensation in respect of such diversion, alteration, supporting, carrying, or dealing with such works. Provided that such works shall be done without unduly interfering with the electrical supply of the company.

7. Any additional expense which the two companies may reasonably and properly incur in widening, altering, reconstructing, repairing or maintaining the cable subway by reason of the existence of any electric cables, mains, pipes or other works of the company over, under or in proximity to the same, shall be paid by the company.

8. In the event of the cable subway or the efficiency thereof being at any time injuriously affected by induction stray currents or otherwise from the generating stations, electric lines or works of the company or in the event of such injurious affection being in the opinion of the engineer of the two companies reasonably probable, the company shall forthwith at their own expense execute and do such remedial works as may be necessary for the protection of the two companies, or if they so elect the two companies, may themselves execute and do such works at the cost of the company.

9. The company shall pay to the two companies all costs, damages and expenses incurred by the two companies by reason of such injurious affection, and shall also bear and on demand pay to the

two companies all reasonable cost of the superintendence by them of the laying down, alteration, improvement, enlargement, extension, maintenance or renewal of, or of the execution of repairs to any cables, mains, pipes or other works of the company and all reasonable costs of watching, lighting and protection of the cable subway with reference to and during such laying down, alteration, improvement, enlargement, extension, maintenance, renewal or repairs as aforesaid.

10. Any dispute or difference which may arise between the two companies and the company with reference to the provisions of this section or in any way arising thereout, or as to any works to be carried out in pursuance thereof shall be settled by arbitration by an engineer or other fit person to be appointed by the Board of Trade on the application of the two companies and the company or either of them.

For the protection of the Baker Street and Waterloo, the Charing Cross, Euston and Hampstead, and the Great Northern, Piccadilly and Brompton Railway Companies (hereinafter referred to as "the protected companies"), and in addition to any other provisions for their protection contained in this Act the company shall not (except with the consent in writing of the protected companies or such of them as may be affected) in any manner interfere with the railways tunnels, stations, approaches, subways, passages, and other works which the protected companies are now authorised to construct, or which they may be authorised to construct by any Act passed in the present session of Parliament.

L.C.C. Tramways.

(*Concluded from page* 847.)

Wednesday, May 24th.

Evidence was given by Mr. JOHN BURNS, M.P. He was of opinion that instead of adding to the congestion of the traffic, the tramways would tend to relieve it. He admitted that the Embankment was not a good road—it was made by the old Board of Works.

Mr. FITZMAURICE, the engineer to the Council, was then recalled as to the space between the lines on Westminster Bridge. If the two lines were laid 2½ ft. off the centre of the bridge, the space between them could be reduced to 9 ft. 7 in.

Mr. BAGGALLAY addressed the Committee on behalf of the frontagers on the Embankment, and called a number of witnesses.

Mr. ESTALL, of the Metropolitan Railway Co., was then called, and said that for a distance of 740 yd. the proposed tramway would run over the top of the railway tunnel. The distance between the roadway and the tunnel was, in places, as little as 18 in. He understood that the conduit system required a depth of 30 in.

Mr. POLLOCK, K.C., said that he had not said that 30 in., was always necessary.

WITNESS, continuing, remarked that if the roof of the existing covered way, which was of iron girders, had to be reconstructed, it would, perhaps, cost something like £25,000.

Thursday, May 26th.

Mr. FREEMAN, addressing the Committee on behalf of the Metropolitan Railway Co., complained that the tramways would, without doubt, be serious competitors with the railway company if they were allowed along the Embankment. There was not, he submitted, any reason why the Committee should reverse the decisions which had been come to by other Committees of that House. Dealing with the proposal to cut into the top of the tunnels, Mr. Freeman continued that the sanctioning of such a thing might lead to disaster. It was to be remembered that the conduit system would be the system of traction adopted for the proposed tramway, and his contention was that, as in some places there was only 1 ft. 6 in. between the surface of the roadway and the top of the arch of the tunnels, there would not be sufficient room.

Capt. J. W. NOTT BOWER, Commissioner of the City Police, was then called. He considered that the proposed tramway over Blackfriars Bridge would lead to a great disturbance and congestion of the traffic, but added that if the bridge were widened at the Embankment end, his objection would not be so great. The point in question was "the most difficult crossing in London."

Mr. E. R. HENRY, Chief Commissioner of the Metropolitan Police, gave evidence as an independent witness. In reply to the CHAIRMAN, he said that in his opinion the tramway over Westminster Bridge would greatly add to the congestion of Bridge Street near the Houses of Parliament. The traffic at that point was very heavy.

Sir RALPH LITTLER then shortly addressed the Committee on behalf of the Corporation of London. He said that the City had always wished to do all in its power to assist the working classes who came into it every day. But these tramways could never be anything but an obstruction. If any communication by tramway from North to South was really necessary, and he would not admit that it was, the only sensible way to secure it was for the L.C.C. to construct another bridge between Waterloo and Blackfriars.

Mr. ERSKINE POLLOCK, K.C., in his reply, dealt with the various points raised by the opponents of the Bill, and the CHAIRMAN remarked that the Committee would reserve its decision.

Friday, May 26th.

The CHAIRMAN (Mr. Kearley) said that the Committee were prepared to pass the preamble of the Bill, with the exception of the proposed connection with the subway under Kingsway. The widening of Blackfriars Bridge was imperative.

Sir RALPH LITTLER remarked that no such power was taken by the Bill.

The CHAIRMAN said that he was aware of that. The Committee knew what clause it was they wanted. They would not pass any clause which was *ultra vires*.

Wednesday, May 31st.

The Committee had before it the proposal of the L.C.C. concerning the condition to widen the bridge, and it was declared that unless there was an agreement arrived at between the City and the Council, it was useless to proceed with the Bill. The matter now stands over until June 26th.

L.C.C. (General Powers) Bill.

Wednesday, May 24th.

MR. J. W. WILSON'S Committee of the House of Commons considered the electrical clauses in this Bill. The clauses, No. 62 and 63, in the Bill were as follows:—

"To empower the Councils of the Metropolitan Boroughs being authorised to supply and supplying electricity to provide, sell, let for hire, fix, set up, alter, repair and remove wires, lamps, motors, meters and all manner of electrical machinery and apparatus, and to expend money upon the wiring and fitting and supplying with wires, fittings, machinery and apparatus the premises of any of their consumers, or prospective consumers, of electrical energy, and to enter into and carry into effect agreements and arrangements with respect thereto, and to make such charges therefor, whether directly or otherwise, as they may think fit."

"To empower the Councils of the Metropolitan Boroughs, or any of them, to borrow in the same manner, and subject to the same conditions as if such expenditure were for the purposes of the Electric Lighting Acts, 1882 and 1888, as amended by any subsequent Act, and upon such terms and conditions as to repayment and otherwise as may be specified in the Bill such sums of money as may be required by such Councils for the purposes hereinbefore mentioned."

Lord ROBERT CECIL, K.C., read the clauses to the Committee, and remarked that the Committee would see that the clauses applied only to those Borough Councils which actually supplied electrical energy. They would also notice that it was the Metropolitan Borough Councils only who were to be so authorised, and not the L.C.C. directly. The Council had put such proposals forward more than once. They did so in 1902 and again in 1903, but the clause in question had never yet been before that Committee. Since that time two of the Metropolitan Boroughs—Woolwich and Marylebone—had obtained clauses enabling them to supply electrical fittings. Lord Robert then cited a number of precedents for the clause from various parts of the country, and said that 20 of the borough councils had written to the L.C.C. urging them to obtain the powers. The Hackney Borough Council on February 8th, 1904, passed a resolution calling upon the L.C.C. to apply to Parliament. Counsel submitted that it seemed only right that a local authority should be able to carry on its business with a reasonable possibility of success. The Council were, however, of opinion, that some undertaking should be given that no charge should fall upon the rates, and with this object in view they would agree to the insertion of a protecting proviso. The Westminster City Council was the only local authority against the proposal, but they were not represented by counsel. Counsel then dealt with the opposition of the gas companies, and read portions of the petitions of the South Metropolitan Gas Co. and the Gas Light & Coke Co. The petitions alleged that there was a possibility that as ratepayers they would be called upon to bear part of the cost of what was really a competition with them. Learned counsel thought that if it was right for the Borough Councils to have the clause, it was only right that all the ratepayers should contribute to the public purpose which the municipal authority was carrying out. However, he admitted that there did seem to be a superficial unfairness in making a gas company pay for what was really competition with them, although he thought that the protecting proviso that no charge should fall upon the rates was sufficient to protect the gas companies.

In reply to the CHAIRMAN, Lord ROBERT said he did not think that dynamos would come within the terms of the clause. When Woolwich got its powers a proviso was inserted that they should not manufacture any of the machinery themselves. The L.C.C. did not intend to put up a manufactory. Dealing with the petitions of various companies supplying electrical energy within the area of the Administrative County of London, counsel said that as a matter of fact, there were only two cases in the metropolis where there was competition between a company and a local authority—Camberwell and Bermondsey—so that only in these two cases could there be any competition in the supplying of fittings. He thought that in those cases where the local authority was competing with a company, it was only fair that the local authority should have the same facilities for supplying fittings as the company had.

Mr. HENRY MILLS, the chairman of the Lighting Committee of the Islington Borough Council, was then called. He said that the canvasser of the lighting department of the Council had reported to the Committee that if the Council were able to supply motors the number of customers would be very largely increased. From a ratepayer's point of view it would be an advantage that the number of consumers of the light or power supplied by a local authority should increase.

Cross-examined by Mr. BALFOUR BROWNE, K.C. (for the Electric Lighting and the Gas Co.), WITNESS admitted that the clauses were struck out in 1903. It was a fact that in the two cases where the powers had been given, they had been given on the direct application of the authorities themselves, and not by a general Bill. Before a Borough Council supplied a householder they would no doubt make sure that their rental or payment was secure.

In reply to Mr. Neville (for the Putney and Wandsworth Gas Co.), Witness admitted that gas companies or similar corporations, although very large ratepayers, had no direct voice in the administration of the rates.

Mr. Neville asked witness if he would be prepared to support an alteration of the clause so that the charge made for the current should include interest and sinking fund on the money proposed to be borrowed by the Borough Councils from the London County Council.

Witness thought that the clause as it stood, with the addition of the proviso, afforded all the protection that was needed.

Mr. Hutchinson (for the Electrical Engineers and Electrical Contractors' Association): You would put in these County Council motors at cost price?

Witness: I didn't know there were any County Council motors.

Mr. Hutchinson: But you would put in the motors and the fittings as cheaply as you could?

Witness thought that they would. He was not aware that although Ealing had power to supply fittings, they were bound to supply them through a contractor.

Mr. Hutchinson proceeded to cross-examine witness with respect to an agreed clause between the Electrical Contractors' Association and the Borough Councils' Association. The clause, he said, was agreed to with a Mr. Alderman Pritchard.

Lord Robert Cecil objected that the clause had not been referred to in the petition of Mr. Hutchinson's clients.

Mr. Hutchinson admitted this, but he said that he had a perfect right to cross-examine on the question, on account of Lord Robert Cecil's taking up the position that he appeared as the representative of the Borough Councils. The matter would have been referred to in the petition, but when the petition was drafted, it was understood that Lord Robert appeared only for the L.C.C. Mr. Hutchinson said that if the Committee would allow him, he would call evidence to prove that the clause had been agreed to.

The Chairman of the Committee said that he could not advise counsel as to what evidence should be called.

In reply to members of the Committee, Witness said that he was a member of the Borough Councils' Association, and he knew nothing about the alleged agreed clause.

Mr. Bryceson, the Town Clerk of Woolwich, said that the sale of fittings in that borough had been self-supporting; there had been no charge on the rates.

Cross-examined by Mr. Hutchinson: It was a fact that the Council had no completed financial year's account. He thought that they were earning a small profit. He could not say how much they spent upon materials, but roughly he should say about £1,000 up to the present time. They had no "dead" stock; they did not buy sufficiently largely for that.

Mr. Hutchinson: You buy from hand to mouth?—I don't say that. He knew that there were no electrical manufacturers in Woolwich now; but he did not remember that there was ever more than one such firm in the place.

In reply to the Chairman: The Council would certainly put in a motor costing £200 or £300 to install. They had, however, never had so large a motor to put in; the largest was probably worth about £65.

Mr. R. Preston, Town Clerk of Fulham, was called as to the alleged agreement which had been entered into by Mr. Alderman Pritchard. Witness said that he was a member of the Executive Council of the Metropolitan Borough Association, and the first he heard of that clause was that morning in the Committee Room. Certainly the Association did not authorise Alderman Pritchard to enter into any agreement.

At the conclusion of witness's evidence, Mr. Freeman, K.C. (for the L.C.C.) intimated that he had a number of witnesses from places outside London, from Bradford and places in the North.

The Chairman said that as the matter had often come up before Committees he did not think there was any necessity to hear the witnesses in question.

Further evidence having been called, the Committee decided that the clauses should stand part of the Bill. The exact wording of the clauses would be decided on Thursday.

Thursday, May 25th.

Before proceeding to the consideration of clauses, the Chairman remarked that in arriving at their decision on Wednesday, the Committee were entirely unanimous.

Mr. Freeman, K.C., for the County Council, said that, in consequence of the decision, the words "whether directly or otherwise" having relation to the manner in which a borough council might charge for wiring, fitting, and apparatus had been struck out of Clause 63. The County Council and the gas companies had agreed to the following provisos to the clause:—

"1. Provided also that every such council shall so adjust the charges to be made by them as aforesaid as to meet any expenditure by them under the powers of this section, including interest upon any monies borrowed under and for the purposes of this part of this Act and payments to sinking fund in respect of such monies.

"2. Every sum charged by any such council to a consumer in respect of the wiring and fitting of the premises of such consumer and the supplying of wires, fittings, motors, and apparatus shall be clearly stated on every demand note by such council for payment for electrical energy supplied to such consumer distinct from the charge for such energy. The total sums received and expended by any such council under this part of this Act in each year, including the amount required for interest on and payments to sinking fund, in respect of any monies borrowed, shall be separately shown in the published accounts of the electric lighting undertaking of such council for such year."

Counsel for the gas companies having agreed to these amendments, the Committee gave its approval to the amendment in Clause 63 and the new provisos, and inserted them in the Bill.

The Telephone Agreement.

Tuesday, May 30th.

The Select Committee of the House of Commons, under the Chairmanship of Mr. Stuart Wortley, sat on Tuesday to consider the agreement which has been provisionally made between the Postmaster-General and the National Telephone Co. for the purchase of the company's undertaking.

Sir Robert Hunter, solicitor to the Post Office since 1882, was the first witness called, and stated that he had been familiar with all the important questions relating to the telephonic service of the country. On July 24th, 1900, an injunction was obtained against the National Telephone Co., preventing them opening streets in London without the consent of the Postmaster-General, and that was undoubtedly one of the reasons which induced some co-operation between the company and the Post Office, for the growth of the business made it incumbent on the company to extend their underground wires. The company's licence expired in 1911, and the company would have no power after that date of sending a single message between two independent persons, although they would have power to lay private wires. There was no provision in the licence for the purchase of plant. The company was not bound to sell, and the Postmaster-General was not bound to purchase their plant. About this time (1900) the company wanted fresh capital, and the only security they had to offer the public was a security which was becoming less valuable every day. At the same time the Postmaster-General was under an obligation to start a telephone system in London, but the great difficulty in his way was that he could not offer communication with the subscribers of the National Telephone Co., and further, the company could make any charges they liked, and were not bound to give the same terms to all persons. At that time a deadlock appeared imminent unless some agreement was come to whereby the Postmaster-General could obtain facilities, and the company were able to lay underground wires. Accordingly, negotiations took place as regarded the London area of the company in 1901, and it resulted in an agreement being entered into in the same year. The main provisions of the agreement were, first, that there was to be intercommunication without any charge between the subscribers and the Post Office exchanges, and the subscribers of the National Telephone Co.; secondly, the company were to supply telephonic communication to all persons without favour or preference; thirdly, certain schedule rates were agreed on to be charged by both concerns; fourthly, the Postmaster-General was to provide underground wires for the company; and fifthly, at the expiration of the company's licence in 1911, the Postmaster-General was to buy the company's London plant on terms which were generally known as tramway terms. This agreement was approved by Parliament after a debate, and it had given a great impetus to the telephonic business. From February, 1902, when the agreement came into force, to the end of last year, the Post Office had obtained 22,000 subscribers, while the National Telephone Co. had increased their subscribers by the same number. The Telephone Co. had 71,417 telephones in London, and they had altogether in the country 315,829 telephones, and consequently the agreement of 1901 had a very material bearing on the whole matter. So far as the telephonic business of the country at present was concerned, the Postmaster-General worked the trunk wires. These comprised nearly 60,000 miles of double wire and over 400 trunk centres, and represented an expenditure of about £2,500,000. It was the most extensive trunk telephone system in the world. Then the Postmaster-General had his London exchange system, and also about 300 small exchanges in the country. The latter were mostly in rural places, and comprised altogether about 7,000 subscribers. The capital expenditure on these exchanges (including London) was over £2,000,000. Then there were five municipal telephone exchanges with the following licences:—

Glasgow, licence terminating in 1913.
Hull, licence terminating in 1911.
Swansea, licence terminating in 1920.
Brighton, licence terminating in 1926.
Portsmouth, licence terminating in 1926.

The National Telephone Co. had exchange systems in all the more populous towns and districts in the country, and according to their published accounts their expenditure on their business generally had amounted to £10,500,000. The proportion of messages passing over exchange lines as compared with those over trunk lines was about 95 per cent. It might be stated roughly that nine-tenths of the telephonic business of the country was in the hands of the Telephone Co., and consequently as in 1911 the Telephone Co. would be unable to work a single exchange the telephone system would come to a standstill unless some arrangement were come to. On the other hand, the Telephone Co. would have no purchaser for its plant. But, further, there was another matter for consideration. Unless some agreement were come to, it was probable that difficulties would arise before 1911, because the Telephone Co. would limit its operations and charge more before the expiration of the licence in order to be able to replace at least some of its capital. It was essential, therefore, that some arrangement should be made by the Postmaster-General to carry on the business. The municipal exchanges were so few that they would not have a material bearing upon the matter, and therefore the duty fell on the Postmaster-General to continue telephonic communication. To do that there seemed to be only two ways. Either the Postmaster-General would

have to construct independent plant so that on 1st of January, 1912, he would be able to go on with the telephonic system, or he would have to come to some arrangement with the Telephone Co. to take over the plant of the company on January 1st, 1912. With regard to the first alternative, speaking generally, it would take six or seven years to construct plant equal to that which the National Telephone Co. had at its disposal. Consequently the construction of such plant should have been begun by now. Secondly, it was obvious that if such a course were pursued there would be an enormous waste of capital in duplicating the plant. Sir Robert Hunter proceeded to deal in detail with the clauses in the published provisional agreement, and said the main effect of it would be to enable the Postmaster-General to take over the company's business in 1911. There would be no good-will paid, except in the case of the private wire business, and where, owing to municipal competition, the company had got an extension of their licence. In the case of the private wire business three years' purchase would be paid. Summing up the effect of the agreement, the witness said the first great advantage was that it provided for the continuance of the telephonic service of the country without a break, and it supplied the Post Office with plant at the price which it would have to pay if it constructed it itself. From the company's point of view, he understood that they considered it would enable them to raise sufficient additional capital as might be necessary to meet the demands which might be made upon them to meet an extended service.

By Mr. Benn: The Postmaster-General had not formed any estimate as to the liability which the purchase clauses of the agreement would entail. They knew that the Telephone Co. said they had spent 10½ millions on their undertaking, but it was very difficult to arrive at a figure, because it was not the plant which the company had now which they had to purchase, but any additional plant which they might erect before 1911.

The Committee then adjourned.

Metropolitan Pneumatic Dispatch Bill.

(*Concluded from page* 847.)

Thursday, May 25th.

Further witnesses were called, among them Mr. C. A. Brereton, the engineer to the scheme, who said that he had seen the working of the tubes at New York, Boston, and Philadelphia. In those places the carriers travelled at 30 miles an hour; collision was avoided by the maintenance of a distance of 100 yd. between the carriers. A heavy carrier would not attain the maximum speed all at once, but the fact that it was followed by another and a faster carrier would compress the air between the two, and the reaction would, of necessity, force the first carrier along more quickly until the maximum speed was reached. He did not see any difficulties in the way of the scheme.

Monday, May 29th.

Mr. J. R. Marriott, the solicitor to the promoters of the Bill, was called. He went at some length into the negotiations which preceded the application to Parliament. Out of 29 local authorities in London, 19 petitioned against the Bill originally. Seven of these had now withdrawn their petitions, while four who had presented petitions were not appearing by Counsel. The eight petitioners who remained were, therefore—Paddington, Camberwell, Lambeth, Hampstead, Fulham, Shoreditch, Marylebone, and the City. In this connection, he said that he wished to point out that the actual course of the pipes would be left to the decision of the local authorities. In the case of some of the local authorities, terms had already been agreed to, and similar terms had been offered to the remaining petitioners. An offer had been made to all the electric lighting authorities and companies in the County of London, setting forth the terms upon which a supply of electrical energy would be taken from them, but no agreements had yet been made. It was absurd to suggest that the company would go on laying tubes in all directions. It was true that they took power to lay them wherever they wished, but it was to be remembered that the tubes would cost £30,000 a mile as a whole, and the company would not be likely to lay down miles of tubes for amusement. The promoters had agreed to carry on the work of construction in certain districts between midnight and 8 a.m.

Cross-examined by Sir Ralph Littler, K.C.: Witness would not admit that the scheme was merely an experiment. Similar tubes had been used before.

Witness having been further cross-examined, the Chairman ordered the room to be cleared, and without having heard the case for the opposition, the Committee found the preamble not proved.

Croydon Corporation Bill.

Friday, May 26th.

This Bill came before Lord Newton's Select Committee of the House of Lords.

Mr. Gerald Fitzgerald, in opening the case for the promoters, said that the Bill was to authorise the construction of certain linking-up lines and tramways in Croydon. It had already passed the Police and Sanitary Committee of the House of Commons. Clause 4 dealt with the electrical part of the Bill, and was in three parts, one of which was opposed, and this was the only opposition to the Bill. The opposition came from the County of London Electric Supply Co., the South Metropolitan Tramways and Lighting Co. and the South London Electrical Supply Corporation. As regarded that particular portion of the Bill, those same petitioners came before the other House, and their *locus* was objected to before the Court of Referees, who held that they had no *locus* to be heard on the ground that none of their rights and interests were affected by the Bill. That applied to the County of London Electric Supply Co. and the South London Electric Supply Corporation. The South Metropolitan Electric Supply Corporation now petitioned against another part of the Bill. The clause was as follows:—"If the local authority for any district adjacent to the area which the Corporation are for the time being authorised to supply with electrical energy shall be authorised by Act of Parliament or provisional order confirmed by Parliament to supply energy, or if any company wish to be so authorised to supply energy within any such district; the Corporation and such local authority or company as the case may be, shall enter into and carry into effect agreements for the supply of electrical energy in bulk by the Corporation to such authority or company." Mr. Fitzgerald remarked that the clause was merely a permissive clause.

Mr. Frederick Chas. Lloyd, the town clerk of Croydon, was called, and said that the clause was a very common clause. At the present moment the clause would only enable the Corporation to supply petitioners. He quoted a number of precedents for the insertion of the clause.

After hearing Mr. Moon, K.C., for the opposition, the Chairman of the Committee said that they had decided that they would not allow the clause. The rest of the Bill, which was unopposed, then passed.

Steam Engines and Boilers (Persons in Charge) Bill.

In the House of Commons last week, Mr. J. Walton moved the second reading of this Bill, which provides for the granting of first-class certificates to any person who shall produce satisfactory evidence that for not less than 12 months before the commencement of this Act he has within the previous five years had the practical charge or control of a boiler or engine of 5 H.P. or upwards. A person who produces to a Secretary of State testimonials from at least two persons, showing that he is, in point of character, knowledge, physical ability and experience, fit to receive a second class certificate, shall be entitled to receive such certificate. An applicant shall pay to the Secretary of State a fee not exceeding, in the case of a first-class certificate, the sum of 5s., and in the case of any other certificate, 2s. 6d. The Bill imposes penalties upon any person who shall take charge or control of, or employ another person to take charge or control of, any boiler or engine to which the Bill applies.

Sir W. Tomlinson moved that the Bill be read a second time in six months. Debate adjourned.

Electric Lighting Provisional Order (*No.* 9).—On Friday the Bill confirming provisional orders granted by the Board of Trade under the Electric Lighting Acts, was before the Examiner, and was ordered to be reported for third reading. The Bill confirms orders to the Brentford Electric Supply Co., in respect of the Urban District of Brentford; to the County of London Electric Supply Co., Ltd., in respect of the parishes of Addington, Beddington, Coulsdon, Mitcham, Morden, Sanderstead and Woodmansterne, Surrey; to the County of Durham Electrical Power Distribution Co., Ltd., in respect of certain parishes in Durham; to the Corporation of Eastbourne, in respect of the parish of Willingdon; to the Gravesend Corporation, in respect of Northfleet; to the Kingsbury U.D.C., in respect of Kingsbury; to the Windsor Electrical Installation Co., Ltd., in respect of Old Windsor; and to the Bournemouth and Poole Electricity Supply Co., in respect of a number of parishes in Dorset.

Electric Lighting Provisional Order (*No.* 8) *Bill.*—This Bill, which originates in the Lords, has passed the Standing Orders stage. It confirms orders granted to the Scottish House-to-House Electricity Co., Ltd., in respect of the Burgh of Airdrie; to E. J. B. Lowdon and K. Lowdon, in respect of a portion of the Parish of Peterculter; and to the Scottish House-to-House Electricity Co., Ltd., in respect of the Burgh of Coatbridge.

Shepton Mallet Gas (*Electric Lighting*) *Bill.*—This Bill came before the Unopposed Committee of the House of Lords, on May 23rd, when it was ordered to proceed. The measure seeks to empower the company to generate and supply electricity within their limits of gas supply.

Tramway Confirmation Orders.—Tramways Confirmation Orders Bills (Nos. 1 and 2) have passed the Examiners in respect of Standing Orders. No. 1 Bill confirms orders to the Bradford Corporation to construct about 2½ miles of tramway; to the Gorton U.D.C., to construct about 1 mile; to the Corporation of Keighley, to make several small junctions; to the Leeds Corporation, to construct about 1½ miles; to the Liverpool Corporation, to construct about 4 miles; and to the Pudsey Corporation, to construct about 7½ miles. No. 2 Bill confirms orders to the Aberavon District Tramways Syndicate, Ltd., to construct 1½ miles; the Luton Corporation, to construct about 6½ miles; the Colchester Corporation, to construct about ½ mile; the King's Norton and Northfield U.D.C., about 1 mile, joining up with the tramways of the Birmingham Tramways Co.; the National Electric Construction Co., Ltd., amending the Portobello orders of 1900 and 1903; and to the Southampton Corporation, to construct 1 mile of tramway.

South Lancashire Tramways Bill.—This Bill came before Lord Balfour of Burleigh's Committee on Unopposed Bills on May 23rd. It appears from the preamble that the South Lancashire Tramways

Co., which have a very extensive system, are authorised under various Acts to raise capital to the extent of £1,450,000, and of this £489,244 has been issued to the South Lancashire Electric Traction and Power Co., Ltd., who have constructed a large portion of the tramways authorised by the Acts. In 1896 the Lancashire Light Railway Co., Ltd., got an order empowering them to construct a light railway from Liverpool to Prescot, and they have issued shares to the amount of £49,377 to the South Lancashire Electric Traction Co. The South Lancashire Electric Traction Co. have issued ordinary shares to the amount of £250,000, preference shares to the extent of £110,132, and debenture stock to the amount of £600,000; but, as the company were unable to pay the debenture interest, a receiver had been appointed. The South Lancashire Tramway Co. are seeking to acquire the assets of the Traction Co. and the undertaking of the Lancashire Light Railways Co., and to enable them to do this, and also to enable authorised tramways to be constructed, the company want power to rearrange their capital, and to create and issue debenture stock. The usual formal proofs were given, and the Bill was ordered to be reported for third reading.

Gosport and Fareham Tramways.—The Bill promoted by the Portsmouth Street Tramways Co to construct additional tramways in the urban districts of Gosport, Alverstoke and Fareham, came before the Unopposed Bills Committee of the House of Lords on May 23rd. The Committee ordered the Bill to proceed.

Electric Lighting Provisional Orders (No. 7) Bill.—This Bill came before the Unopposed Committee of the House of Commons on May 25th when it was ordered to proceed. The Bill confirms orders to the local authority of Bishops Stortford; to the Dover Corporation in regard to the Rural District of Dover; to the Hemsworth Electricity Supply Co., in regard to part of the Rural District of Hemsworth; to the Marlborough Electric Supply Co., in regard to the Borough of Marlborough; to the Lancashire Electric Power Co, in regard to the Urban District of Tollington; and to the Woking Electric Supply Co. in regard to an extension of their area to the Rural District of Chertsey.

Workmen's Compensation Bill.—In the House of Lords on Monday this Bill was read a third time and passed, after several amendments relating to sub-contracting had been inserted. The Earl of Wemyss thought it ought to be known to workmen that legislation of this character tended to lower wages.

Second and Third Readings.—In the House of Commons on Wednesday, May 24th, the Great Northern, Piccadilly and Brompton Railway Bill (No. 1) Bill was read a third time.

In the House of Commons on May 25th the Mexborough and Swinton Tramways (Extension of Time) Bill was read a third time.

In the House of Lords on Thursday, May 25th, the London United Tramways (Extension of Time) Bill was read a second time.

In the House of Lords, on 29th ult., the following Bills were read a third time:—Metropolitan Railway Co., Gosport and Fareham Tramways, Hastings Tramways, and South Lancashire Tramways.

Metropolitan Railway Bill.—This Bill, which is to authorise the Metropolitan Railway Co. to take over the Harrow and Uxbridge Railway, and to raise additional capital to the extent of £800,000, passed the Unopposed Bills Committee of the House of Commons on May 25th. The Chairman of the Committee, in reporting to the House on the Bill, states that the Committee considered a report from the Board of Trade as to the rates on the transferred undertaking being assimilated to those in force on the Metropolitan Railway, but after hearing evidence they were of opinion that the recommendations of the Board of Trade need not be insisted upon.

Hastings Tramways Bill.—On May 23rd this Bill, which gives the Hastings Tramway Co. an extension of time for the completion of their works, and also power to abandon portions of the authorised undertakings, was before the House of Lords Committee on Unopposed Bills. Formal evidence proving the preamble was given, and the Bill was ordered to be reported for third reading.

LEGAL.

Birmingham Corporation *v.* Birmingham Canal Navigation.

In the Chancery Division of the High Court on Thursday, May 25th, Mr. Justice Farwell delivered his reserved judgement in this case.

His Lordship said that plaintiffs claimed to be entitled under the provisions of defendants' Act to take water from the Birmingham and Fazely Canal for the purpose of their generating station, from which they proposed to supply electricity for lighting their city and in due course for working their tramways and other purposes. The amount of water proposed to be taken was at present about 250,000 gallons an hour, and the claim was to take it free of charge. The question turned on the true construction of Sec. 82 of William the Fourth of 1834. The plaintiffs contended that their generating station was a manufactory within the meaning of the section. The defendants contended that the only manufactories entitled to the benefit of the Act were manufactories belonging to persons who, at the date of the Act, possessed steam engines used for the purpose of such manufactories, or in other words, that additional steam engines were allowed to manufactories then using steam engines and nothing more, and that even if this was not so, a generating station was not a manufactory within the meaning of this particular Act. *Primâ facie*, the words "the above manufactures" must mean the manufactories mentioned above, and that only the manufactories so mentioned were those having steam engines in existence at the date of the Act. It was said that the reference to the future acquisition of the land and the future extension of the canals excluded this view, but it had to be observed that it was the future erection of the manufactories which was mentioned as contemplated, and it was quite possible that engines might be erected after the Act on land thereafter acquired within the 200 yards of canals thereafter cut, and yet be for the use of manufactories existing at the date of the Act. Further, the Act distinguished on the face of it between manufactories and cornmills, collieries, ironworks and other works. The manufactories were qualified by the use of the word "above." Cornmills had no such qualification, and collieries, ironworks, and other works had no claim to draw water for any new engines at all. As a matter of construction, he did not think it possible to read the words in other than their *primâ facie* meaning, but Mr. Parker had invited him to read the words "the above manufactories" as "any such manufactories as are mentioned above," or to alter the "above" into "any." His Lordship said he could only do this on the ground that there was some ambiguity in the word used, and that there was a paramount and general intention clearly expressed, with which the *primâ facie* construction was inconsistent. His Lordship was unable to find any such clear general intent. The Section undoubtedly contemplated the existing state of things, and that only in reference to collieries, ironworks, and other works, and there was, therefore, no apparent reason why the existing state of things should not be equally intended with respect to manufactories. When he turned back to the series of Acts referred to in the preamble, he was confirmed in this view. The reference he drew was that steam engines had been erected, and were in use for some manufactories and corn mills under an Act of George the Third, and also for some ironworks, collieries, and other works, and without any statutory authority, and that the *status quo* was preserved as to all these with the additional right in the case of existing manufactories to erect and use further and other engines for such manufactories on the existing canals, and also on canals thereafter to be made, while all cornmills within the limits had the right, whether erected before or after the Act. He saw nothing unreasonable in this construction, but even if he did this apparent unreasonableness would not justify him in striking out the word "above," or altering the plain words of the section. If the general purview of the Act was, as Mr. Parker suggested, the mutual advantage of the Canal Co. and the town of Birmingham, he could see no reason for extending the words to all manufactories in face of the fact that all collieries, iron and other works were not included, and that Birmingham was the home of the metal trade. Even if he could read "above manufactories" as equivalent to any manufactories similar to those mentioned "above," he did not think that a generating station could fairly be deemed to be included therein. It was not a question of what was a manufactory generally, but what did that word under this section of the Act mean? Mr. Parker defined a manufactory as "a place prepared and fitted for producing a merchantable article for the market," and said that this generating station answered that description; but if it did, that could not be the meaning in which it was used in this Act. Ironworks and other works answered the description at least as well, and they were obviously not included. The rule that statutes extended by inference to cases not originally contemplated, depended on showing that the statute dealt with a genus within which the new species was brought. But if the statute showed plainly that the word was not used as describing the whole genus put forward as the one applicable to the case, but only some particular species therein, the rule had no application. His Lordship had heard no evidence to inform him of the exact process by which electricity was generated, but whatever it be, it was certainly unknown in 1835, and if he was to read the 82nd section authorising the taking of water for steam engines for manufactories, but not for collieries, ironworks or other works near Birmingham, and had to determine under which head a generating station fell, he should say the latter. It might be works, but he could not see how it could be a manufactory as distinguished from works any more than gasworks or waterworks would be. The result was that the plaintiffs' claim failed, and that the proper form of judgement would be to declare that the plaintiffs were not entitled under Sec. 82 of the Act of William the Fourth, 1834, to take water from the defendants' canal for steam engines connected with their station for generating electricity. The plaintiffs must pay the costs of the action.

Corporation of Swansea *v.* National Telephone Co., Ltd.

Mr. Justice Buckley on May 25th had again before him the application of the defendants for his Lordship's directions as to what should be done, pending the appeal under the order directing the defendants to connect with the plaintiffs' telephone system.

Mr. Buckmaster, K.C., now said that the plaintiffs were willing to consent to anything that was reasonable, but they could not consent to the time which the defendants' witnesses said was necessary to make an effective intercommunication. Plaintiffs did not desire, pending appeal, to have connection with the defendants' junction lines, and they had evidence to show that an effective local communication with Swansea, Mumbles, and Morriston could be made in 10 weeks.

Mr. Astbury, K.C., for the defendants, said that the system suggested by the plaintiffs' witnesses was obsolete, and would result in a breakdown.

In the result, his Lordship said he would stay the operation of his order pending the appeal, except to the extent that the

defendants should couple up 50 pairs of communications at Swansea, five at Mumbles, and six at Morriston forthwith, those junctions only to be used for local traffic, and the defendants to give user of them forthwith.

Mr. Buckmaster said that plaintiffs would give defendants all facilities for executing the work.

On these terms there was a stay of the order pending the hearing of the appeal, but there was no stay of the taxation, or of payment of the costs. It was arranged that the appeal should be set down at once, and that the costs of the application should be costs in the action.

An Extraordinary Action.

The case of Graham, Morton & Co., Ltd., *v.* Compagnie L'Union des Gaz, which was recently tried by Mr. Justice Grantham in the King's Bench Division, is in some respects the most remarkable we have heard of for some considerable time. The action was brought by Messrs. Graham, Morton to recover the sum of £4,000 for money due upon a contract under which they had erected gas plant for the defendants at Milan, for £78,000. Owing to strikes of workmen in Milan, and damage done by these workmen to the plaintiffs' apparatus, and after the defendants had for 18 months been obtaining the guaranteed results, they refused to pay the £4,000, and counterclaimed £70,000 for breach of contract. After a trial which lasted 16 days, Mr. Justice Grantham gave judgement for the plaintiffs on claim and counterclaim, with costs on the higher scale. One passage of the judgement appears to give an adequate idea of the views of the learned Judge upon the question he had to consider. He said:—

"The history of the case is very remarkable, and, as far as my experience is concerned, quite exceptional, and does not reflect very great credit on the defendants in making such serious charges against a firm who did so much as it was admitted by the defendants' witnesses the plaintiffs did, to assist the defendants in fulfilling their own contracts with the authorities at Milan. It is true that people must be just before they are generous, but in their efforts, I suppose, to be just to their shareholders, they certainly have not been generous in their dealings with the plaintiffs as far as their defence in this action is concerned. Never was an instance in which work of such magnitude was done under such difficulties as this work was begun, continued and completed by the plaintiffs. Never were contractors, according to the evidence of the defendants' engineers, so anxious to fulfil their obligations and spend their money lavishly to enable them to carry out loyally their contract with the defendants. Never did such work receive such commendation by the persons for whom it was done during its progress, and after it was completed as in this case. Yet two years afterwards—or it may be a year or 18 months afterwards—without the slightest complaint until they were asked for the payment of money admitted to be due, and that had accrued to the plaintiffs, they accuse the plaintiffs of what amounts to the grossest fraud in the construction and erection of these works. Instead of using good and contract material they say they used bad material, bad bricks, broken bricks, chippings of bricks, common bricks, and, in fact, rubbish in general, where they ought to have used different material and bricks of a different character, and in places which are subjected to almost the greatest heat that any work can be subjected to, in this or any other country."

Bogota Telephone Co., Ltd.

In the Chancery Division of the High Court on Saturday, Mr. Justice Swinfen Eady heard a petition presented by the Bogota Telephone Co., Ltd., for the sanction of the Court to an alteration of its memorandum by giving the company power to issue debentures.

Mr. Dodd, for the company, said the concern was incorporated in 1900, to establish a telephone installation in the city of Bogota. The company wished to issue a series of debentures with a view to extending their business.

His Lordship thought that would be incidental to the ordinary business of the company, and would not require express power in the memorandum.

Mr. Dodd said the company were advised that they could not issue a series of debentures charged on the assets without power being given them in the memorandum.

His Lordship considered the memorandum to be already inordinately long, and pointed out that power was given to promote any other company and take debentures, but the company could not issue debentures.

Mr. Dodd replied that if his Lordship was of opinion that the alteration of the memorandum was not necessary, the company would be content with his Lordship's declaration. The company only had debts amounting to £20.

His Lordship remarked that the memorandum was in peculiar form, and the company were perhaps justified in desiring to make the alteration. He would therefore sanction the addition to the memorandum as asked.

B.E.T. Co. and Others *v.* Chadwell.

This case came before the King's Bench Division on Wednesday. It was a claim to recover £8,690 for breach of a contract, and £2,000 for loss of profit. It concerned the construction of a light railway near Bideford, North Devon. Defendant did not appear. The case was adjourned until Thursday (yesterday).

National Telephone Co. *v.* Aberdeen Suburban Tramways Co.

Lord Johnston gave judgement in the Court of Session, on 25th ult., in this action. According to the *Dundee Evening Post* pursuers sued for £722 11s. and cost of reconstructing pursuers' poles and wires in the course of fitting up the defenders' electric system of tramways. The work, it was said, was carried out upon the information and direction of defenders, and it was maintained that they were liable for the cost. Defenders denied that they had authorised or undertaken to repay the cost of the work.

Lord Johnston was of opinion that pursuers had no statutory authority, and were not entitled to exercise the powers conferred upon the Postmaster-General under the Telegraph Acts, nor could they claim authority under the Tramways Acts, but the only real ground of action was that the engineer in charge of the overhead work of the defenders undertook that defenders would pay for the work. In his Lordship's opinion the engineer had no authority to bind the defenders, and he, therefore, dismissed the action with expenses.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION.

The annual meeting of this Association was held at the Hotel Cecil, on Tuesday, Mr. W. Davenport (the secretary), presiding.

The report for the year 1904, which was submitted for approval, referred to the lapse of the agreement with the Contractors' Association in December, the benefits that had been hoped for having proved of a more or less illusory character. Since that date attempts have been made by the Contractors' Association to get members of the Manufacturers' Association to enter individually into an arrangement with them for special terms, but the report believes that they have "loyally refused such overtures." With a view to enlarging its sphere of usefulness the Association has been incorporated, and the delay in holding the annual meeting was consequent upon the special work thus involved. Rules regarding the establishment of a benevolent fund for the electrical industry have been drafted, and will be submitted to members shortly for approval. The constant demands upon business firms for Christmas boxes, beanfeast, cricket club and other contributions have become a general tax, and members are urged to refrain from lending their support to such applications. The Committee of the Association will deal more exhaustively with this matter in time for Christmas, 1905. The increase in prices of raw materials made it imperative to take concerted action, and members raised their prices for wire and cables by 7½ per cent., and for flexible cords and electrical fittings by 5 per cent. The cable manufacturers, says the report, followed suit by raising their prices by 15 per cent. The efforts of the Association to obtain redress of certain grievances in the classification of electrical apparatus, and switchboards especially, have been fruitful in securing certain amendments as to classification and terms under which electrical goods are to be carried by the railway companies at their own or at owners' risk. A special circular is to be issued later detailing these concessions.

Among the other matters to which the Committee has been giving attention are:—The retaining of deposits on specifications for an indefinite period, and the payment of non-returnable fees, also the retention of money on executed contracts entailing hardship by the unproductive locking up of capital. On the last-mentioned matter the secretary is inviting reliable information. The Committee objected to certain of the L.C.C. contract conditions as to the supply of electrical fittings, and a favourable reply has been received stating that the matter will be dealt with when fresh specifications are issued. The Committee expresses the opinion that the custom of hire-purchase of motors should not be extended to arc lamps, they being of an entirely different character, and members interested in the manufacture and sale of such goods are invited to express opinions on the point. After referring to the forthcoming electrical exhibition, which is to be held at Olympia in September and October next, members are informed that in the meantime they should refrain from giving support to any other contemplated electrical exhibition. Steps are to be taken to enrol new members in the provinces, and it is proposed to hold a few meetings in the chief centres of industry to forward the movement. Birmingham and Manchester are to be visited at an early date. The Committee retired in a body at the annual meeting, and the members of the newly incorporated association had to appoint a new committee.

The Chairman moved the adoption of this report, and said that the status of the Association had improved, and they would now be in a position to do things that they had been unable to do before. Mr. Clark seconded the motion.

A brief discussion followed regarding certain of the matters mentioned in the report. It was mentioned that three of the largest councils in London had given up their own exhibition schemes, because of the one now being organised for Olympia. In reply to questions regarding railway rates, Mr. Nalder explained what steps had been taken by the switchboard makers in conference with the railway companies leading up to the result that switchboards, instead of being put in Class 5, are to be put into Class 4. The companies wanted to consider switchboards as commercial instruments, and the intention of the B. of T. was then undoubtedly to make another classification for instruments of precision. The question of railway rates generally had not been discussed, but an entry would appear in the June railway classification of goods by merchandise train, stipulating that electric

lighting switches made partly of earthenware and partly of brass should come under Class 3.

In regard to the L.C.C. contract clauses, it was explained that the Council specified for English-made lamps, and then accepted foreign ones. Several members present said that they knew of arc lamp manufacturers who were members of the Association and were offering to hire out arc lamps, and it was decided to further consider the matter.

Mr. Schmahl said that certain firms in the Association had not made the 5 per cent. advance in prices of electric wires, but it was mentioned that there was no actual agreement that all should raise their prices—it was a recommendation—and when the matter was considered at the previous meeting, there were firms who would not guarantee to fall in with the proposal.

Mr. Bevis referred to the apathy of the members of the Association, and the important part that they could play in bringing in other manufacturers, and after several others had spoken on the point, a resolution was passed in favour of a deputation of the Committee visiting the chief centres of industry with a view to enrolling members there.

Resolutions were also passed appointing Mr. Nalder, a trustee for the invested moneys of the Association, in place of Mr. Smith, and transferring the assets of the old Association to the new. Members present pledged themselves not to support any electrical exhibitions other than that at Olympia during the years 1905 and 1906. Some conversation arose on the suggestion which had been brought forward by Mr. Grainger that the Association should have a president, it being considered *infra dig.* for a body with such pretensions to put its own secretary into the chair at its gatherings. He thought that it would give influence and power to the Association to have a president, but he did not want to go against the feelings of his committee. If the matter were premature he was prepared to bring it up later on. Mr. Grainger also proposed that the Association should welcome the electrical members of the Canadian Manufacturers' Association who were visiting this country in July, and Mr. Nalder suggested that to give them a letter of entry to members' factories would be a good thing. The secretary is to ascertain the names of the members of the Electrical Committee who are coming.

The first meeting of the newly incorporated Assocation was then held, and the following Committee were elected, the two marked with an asterisk being new members:—

Messrs. Bevis, Grainger, Lundberg, Nalder, Northcote, Oppenheimer, Patersen, *Clarke, *H. H. Berry.

An auditor was also appointed.

BUSINESS NOTES.

Condensing Plant.—Messrs. Richardsons, Westgarth and Co., Ltd., of Hartlepool, have recently received through their Glasgow agents, Messrs. A. R. Brown, McFarlane & Co., Ltd., an order from the Bent Colliery Co. for a Contraflo surface condensing plant to deal with 40,000 lb. of steam per hour.

Electrical Imports of New Zealand in 1903.—The statistics of New Zealand in 1903, which were published a few weeks ago at Wellington, record an electrical import trade of upwards of £100,000. For Government purposes machinery to the value of £33,525 was imported free of duty. Of this amount £32,566 worth came from the United Kingdom, £330 from Australia, and the balance of £629 from the United States. Electric machinery, subject to a 10 per cent. *ad valorem* duty, was imported to the value of £77,413. The United States supplied £9,190; Germany, £519; Belgium, £1,558; the United Kingdom, £47,472; and the Australian Commonwealth, £18 553. This last item would not represent local manufactures, but rather the re-exports from Australia of goods purchased from Great Britain, Germany, or the United States.

Brush Contracts.—The following further contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

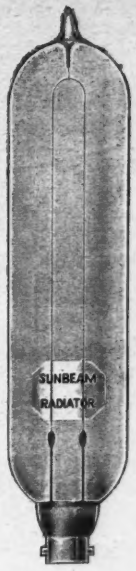
45 standard Brush four-wheel trucks for the Belfast Corporation.
Six electric cars with trucks and Brush motor equipments for the Taunton and West Somerset Tramways Co.
18 double-deck four-wheel car-bodies with standard Brush trucks and Westinghouse equipments for the Midland Railway.
10 double-deck four-wheel car-bodies mounted on radial trucks for the Blackpool, St. Anne's and Lytham Tramways (per B.T.H. Co.).

Engine Contracts.—Messrs. James Howden & Co., of Glasgow, have just booked the following orders:—

Nobel's Explosives Co., Ltd., Linlithgow (fourth repeat order), per Messrs. Siemens Bros. & Co., Ltd., 900-B.H.P. compound engine.
United Co-operative Baking Society, Ltd., Belfast, two engines with 50-KW. Brush Co.'s dynamos.

Sale.—The L.C.C. is prepared to receive tenders for the steam and electrical plant at the Sardinia Street generating station, comprising B. & W. boilers, steam dynamos, Parsons turbo-generators, transformers, switchgear, tools, &c. See "Official Notices" to-day.

Electrical Victoria for Siam.—The Carl Oppermann Electric Carriage Co., Ltd., Camden Town, has just dispatched to the King of Siam a 7-H.P. electrical victoria. The vehicle, which outwardly has the appearance of a petrol car, is painted in red and upholstered in morocco to match. It is fitted with a battery capable of running it about 65 miles on one charge.



Heating Lamps.—The Sunbeam Lamp Co., Ltd., have just issued a leaflet describing their heating lamp for electric radiators, an illustration of which is given herewith. We understand that the firm has had a very large experience in the manufacture of such lamps, Sunbeam heating lamps having been used solely by the Dowsing Radiant Heat Co. for many years in connection with their apparatus. It is claimed for these lamps that they are durable and highly efficient, and, as is pointed out in the leaflet before us, reliable and efficient lamps are in a degree the success of a radiator. Full particulars and prices of these lamps, as well as of a new lamp—the "Outshine"—are given, and copies of the list can be obtained at the Gateshead Works of the firm, or their London office, 102, Charing Cross Road, W.C.

London County Council.—The Fire Brigade Committee reported at last week's Council meeting that the firm whose tender was recently accepted for the wiring of the Rotherhithe station had withdrawn their offer. As the reasons given for the withdrawal were, in the opinion of the Committee, not satisfactory, they suggested that the name of the firm should be entered on the list of persons and firms from whom the Council would not accept tenders in the future.

Dissolutions and Liquidations.—*Re* Shippey Bros., Ltd.—Under the winding-up order made against this company last July, Mr. H. E. Burgess, Assistant Receiver, has now issued his report to the creditors and shareholders. The statement of affairs shows total liabilities £3,289, of which £2,531 is expected to rank against net assets £958, after deducting £18 in respect of preferential claims. The accounts with the contributories discloses a deficiency of £13,633; but Mr. Burgess says that the accounts submitted cannot be accepted as accurate, as no proper accounts were kept, and the figures were principally taken from memoranda and statements furnished by A. Shippey. The company was registered on December 30th, 1887, with a nominal capital of £30,000, divided into 6,000 shares of £5 each. It was formed to acquire the business of Arthur Shippey, trading as Shippey Bros., electrical engineers and American agents, together with the plant, machinery, stock-in-trade, and certain patents rights (British and foreign) of Arthur Shippey. The first directors were Mr. J. J. Michael, Major-General Alexander, and Mr. Arthur Beckwith. Mr. Michael resigned on October 30th, 1888, and Major-General Alexander died in March, 1902. Mr. Arthur Shippey was appointed managing director on June 9th, 1888, at a salary of £300 for the first year, £400 for the second year, and £500 for the third year, with an additional commission of 25 per cent. on the net profits after 10 per cent. had been paid to the shareholders. Mr. Shippey states that he has never drawn the full amount he was entitled to. Under the articles of association, the directors were not to be less than three nor more than seven, but since 1892 Shippey and Beckwith have been the only directors. The last meeting of the board of directors was held in February, 1892, and since that date Mr. Shippey appears to have taken the entire control of the company's affairs. Arthur Shippey started trading as Shippey Brothers in the year 1869, and states that his yearly profits were on an average between £400 and £450 down to the date of the formation of the company, but he prepared no accounts, and there is, consequently, nothing to substantiate this. The purchase agreement, which was subsequently adopted by the company, is dated December 24th, 1887, and is made between Arthur Shippey and F. J. Shippey as trustees for the company. The purchase price was fixed at £8,000, payable as to £3,000 in cash, and the balance by the issue of fully-paid shares. Shippey states that only about £100 in cash was received by him, and fully-paid shares of the company were to be issued for the balance, but the full number of shares to which he was entitled does not appear to have been allotted to him. No valuation of the business acquired was made, the purchase price being fixed by the vendor. On March 12th, 1888, the interest of a Mr. A. Youels in certain patents relative to the business acquired, was purchased for a sum of £3,000, payable as to £500 in cash, and as to the balance in fully paid shares. The cash consideration was not paid, but fully paid shares of the company were issued for the full amount of the purchase price. On the same date the interest of a Mrs. A. P. Lovering was acquired in similar patents, for the sum of £2,000, payable as to £1,000 in cash and the balance in shares. In this case, also, shares were allotted in place of the cash consideration. The Official Receiver is informed that the patents acquired were inventions of A. Shippey which he had charged for monies advanced by them. No prospectus was issued, and no shares, apart from the signatories' shares, appear to have been issued for cash. The total number of shares issued is 2,412 (£12,060). Throughout the company's existence no balance-sheet or profit and loss account has been prepared by the directors, and it is impossible to say the actual result of its trading, although it appears to have resulted in a loss throughout. The company had no banking account, its financial transactions being effected by the largest unsecured cash creditor. The trading books of the company were burnt some four or five years ago in a fire on the company's premises, since which time no proper books of account have been kept. In 1901 an arrangement was come to with the Motor Traction Co., Ltd., of Kennington, by which the latter company were to

finance Shippey Bros., Ltd., in consideration of which they were to receive a proportion of the profits, but this arrangement only lasted for about 18 months. The unsecured indebtedness of the company amounts to £2,481, of which £1,466 is owing to trade creditors, and the balance for cash advances made by friends of Mr. Shippey. The creditors who are fully or partly secured hold a lien on part of the company's property. An item returned as "other liabilities" (£450) represents two claims made against the company. The one is for damages to a motor-car in possession of the company, the other for purchase price of a motor-car of which the company refused to take possession owing to its being defective. In March, 1904, a creditor obtained judgement against the company for £145 and costs, and it was in respect of this judgement that the winding-up order was made.

Edmondson Electricity Meter Syndicate.—This company is winding up voluntarily, with Mr. W. Harrison, 117, Lonsdale Street, Bradford, as liquidator.

Electric-Turbine Gas Retort Charging and Discharging Machine Co.—Creditors must send particulars of debts, &c., to Mr. W. K. Wenham, 27, Martin's Lane, Cannon Street, E.C., the liquidator, by July 11th.

Acetyline Gas and Electric Smelting Co.—The petition by a former agent of this company for a winding-up order came before the Appeal Court again on Wednesday. Mr. Justice Buckley had dismissed the petition on the ground that the debt being under £50 was too small. The case came before the Court a month ago, and was adjourned in order that the petitioner might communicate with the company's works in Norway, but counsel now stated that on making inquiries it had been found that there were no works in Norway, and that there had been misrepresentation. The case had not been put in the list, but they had written to the other side stating that the application for a winding-up order would be renewed. Lord-Justice Vaughan-Williams said they could not deal with a case of that kind in the absence of the respondents, and it was ordered to stand over for a fortnight in order that they might be communicated with.

Garcin Renault Electric Fans and Accumulators, Ltd.—Mr. Justice Warrington, on Tuesday, made an order for compulsory winding up of this company on the petition of a judgement creditor for £95. It was stated that execution had been issued without return. The company did not appear.

Micanite Patents.—Our readers may remember that the Mica Insulator Co.'s German patent has lately been established by a decision of the Supreme Court of Germany. We learn from this company, of Empire Works, Walthamstow, that a very important decision has just been given by the Circuit Judge of the Courts of Delaware, U.S.A., upholding a similar patent belonging to the Mica Insulator Co. of America. The judgement is very exhaustive, and the Judge considers the process of the patent sued upon unanticipated, and that it involves a patentable invention. The patents have thus been supported both in Germany and America, after a great deal of litigation in both countries.

Cricket.—On Saturday last Robertson Lamp Works cricketers met Drake & Gorham players at Twyford Avenue, Ealing, and, after a very interesting game, the lamp-makers were defeated by 35 runs. For the Lamp Works, Ralph took 7 wickets for 22 runs.

Westminster Street Lighting.—We understand that the "Midget" arc lamps approved by the Westminster City Council are the Westminster Engineering Co.'s No. 115 small-type lamps, which have been on trial for about 10 months. They are arranged to burn with a current of 1·2 amperes on the 200-volt circuit, and under these conditions, with one trimming, are stated to burn for 90 hours.

Bankruptcy Proceedings. — John Morley. — The statement of affairs in the failure of John Morley, electrician, of 7, North Street, Hull, shows liabilities amounting to £150, assets valued at £30, and a deficiency of £120. Debtor attributes his failure to sickness in family, depression in trade, losses on contracts, and law costs. He commenced business about nine years ago with a capital of £15, and has drawn £1 9s. a week out of the business.

Trade Announcements.—In order to meet the increased demand for their conduits and fittings, the Simplex Steel Conduit Co., Ltd., are building entirely new manufactories at Garrison Lane and Maxstoke Street, Birmingham. These works are equipped with the most up-to-date machinery and labour-saving appliances.

Mr. F. W. Humber informs us that he has opened works at Wood End Green, Hayes, Middlesex, for the purpose of carrying out repairs of continuous-current dynamos and motors. Mr. Humber has had 13 years' experience in the management of the workshops at Messrs. Newton's, Ltd., Taunton, in all kinds of dynamo and motor work, and his works will be capable of handling armatures up to about 40 H.P.; in the case of larger armatures, he will send skilled men to execute repairs on the spot.

The Kabelfabrik Actien-Gesellschaft (vorm. Otto Bondy) has removed to its new establishment at Oswaldgasse, No. 33, Vienna, XII/3.

The Clift Manufacturing Co., makers of switchboards and central station gear, has been formed into a private limited company, and at a meeting held on May 26th, Mr. Paul W. Rands, late of the General Electric Co., was appointed managing director, and Mr. C. H. Robson, late of the same firm, director and secretary. The works are at Bravington Road, and the West End offices at Dacre House, Victoria Street, Westminster. It is proposed to develop a general supply business as an addition to the existing one.

Book Notices.—*Duncan's Manual of Tramways, Omnibuses and Electric Railways.* London: T. J. Whiting & Sons. 5s. We have received a copy of the 1905 edition of this useful directory, which has now reached its 28th year. Particulars are given of rolling stock, tramway and railway mileage, passengers carried, receipts, expenses, and so forth, wherever obtainable. The editor's prefatory remarks point out that the divergence in the practice adopted regarding renewals and depreciation is still so wide that a proper comparison of different systems is impossible. The compiler finds a notable increase in the ratio of expenses to receipts in nearly all the undertakings which have been working for two years and over. A number of new electric traction undertakings are included in this issue.

The issue of the *Transport and Railroad Gazette* (1s.) for May 26th was a special International Railway Congress issue. It contains a number of interesting articles, printed in English and French, in connection with the recent International Railway Congress at Washington.

A pamphlet has been received from Messrs. Buschmann & Co., of Rio de Janeiro, stating the charges and requirements for obtaining patents and trade mark registrations in Brazil.

"Annals of Physico-Therapy." By Dr. J. Rivière. Fifth year, No. 2, April, 1905. Paris: 25, Rue des Mathurins.

"Instrumente zur Messung der Temperatur für Technische Zwecke." By Otto Bechstein. Hanover: Gebrüder Jänecke. M. 1.80.

"Engineers' Turning." By Joseph Horner. London: Crosby Lockwood & Son. 9s. net.

"The Compound Engine." By W. J. Tennant. London: Percival Marshall & Co. 2s. 6d. net.

"On the Absorption of Electro-magnetic Waves by Living Vegetable Organisms." By Major George O. Squire (Signal Corps, U.S.A.), Ph.D. Reprinted from Maj.-Gen. Arthur MacArthur's report to the U.S. War Department on the military manœuvres in the Pacific division, 1904.

"Die Elektrischen Druckknopfsteuerungen für Aufzüge." By A. Genziner. Hanover: Gebrüder Jänecke. M. 5.

"The American Institute of Architects' Quarterly Bulletin." January, 1905, Vol. V., No. 4. Washington: Glener Brown, sec., The Octagon.

Science Abstracts. Sections A and B. May 25th, 1905, No. 89. London: E. & F. N. Spon. 1s. 6d. net each Section.

Germany.—A company has just been formed in Berlin with a capital of £75,000, to be known as the Berliner Elektromobil Droschken Gesellschaft, to introduce electric motor-cabs and broughams into the German capital.

Catalogues and Lists.—Messrs. Drake & Gorham, Ltd., Westminster. New illustrated catalogue of Nernst lamps and fittings for street and interior lighting. It shows special lines in water-tight covers and various suitable designs of brackets, lanterns, reflectors, &c., for street lighting, and as many electricity supply engineers are interested in the Nernst lamp as a street illuminant, no doubt they will keep the list for reference. A number of special designs of pendants, electroliers, and so on for interior lighting with these lamps are shown. Prices are stated.

Messrs. W. T. Skelding & Co, Ltd, 189, Wolverhampton Street, Dudley. Pocket price list of standard G.B.E. polyphase alternating current motors.

A.E.G. Electrical Co. of South Africa, Ltd., Charing Cross Road, W.C. Their latest pamphlet, No. E 6, containing full description with illustrations and diagrams of their A.E.G. electric pumps, also automatic starters. This pamphlet is also published in the name of the Allgemeine Elektricitäts Gesellschaft of Berlin.

The Crypto Electrical Co., Bermondsey, S.E. New circular giving particulars and illustrations of their alternating to continuous current transformers, together with details showing how to connect them up for charging accumulators.

Messrs. Ferranti, Ltd. List No. 16, giving prices, diagrams of connections, dimensional diagrams, &c., of their indicating and discriminating wattmeter and idle current ammeter for two and three-phase alternating current circuits.

Cambridge Scientific Instrument Co., Cambridge. A number of lists giving illustrations, prices and descriptive particulars of Callendar's apparatus for measuring the mechanical equivalent of heat, the Dolezalek electrometer, laboratory spectrometer, vapour pressure apparatus, &c.

Messrs. E. F. Moy, Ltd. Descriptive price list of Moy & Bastie's resistance units.

Stolzenberg Patent File Co., 50—52, Bishopsgate Street Without, E.C. "Engineering list No. 26" detailing with explanatory illustrations the Stolzenberg system of filing and organisation, card index cabinets, &c., which are in vogue in a number of electrical establishments in this country.

Messrs. Brown, Boveri & Co., Baden. Two fully illustrated brochures (1), describing the three-phase 40,000-volt power transmission from Gromo to Nembro (Lombardia), which was the subject of a detailed article in the Electrical Review last year, (2) giving a complete description, with many half-tone and diagrammatic blocks, of their automatic overload and reverse current relay. Both lists are in the English language.

Messrs. Siemens Bros. & Co., Ltd., Westminster. Three new publications have come to hand. In Price List No. 6B, carbons suitable for open-type arcs are listed in four classes—"A," "R," "T," and "U," the first being the best quality. A special class—mark "E"—is specially made for all enclosed arc lamps, and is claimed to give excellent results; "S A" is used for search-lights. Price List No. 3G details meter-testing boards for central stations, which are intended to meet the want for a standard apparatus for

the rapid and methodical testing of consumers' meters. Three meters can be tested at a time. They are standardised for continuous currents up to 150, 300 and 550 volts; for 550 volts; for single-phase meters up to 150 and 300 volts on non-inductive circuits; and for single-phase and three-phase meters up to 150 and 500 volts on inductive circuits. The other circular, "Y M 110," briefly describes the Siemens marine type ammeter, which can be used for any value of current up to 100 amperes by merely substituting a different shunt.

LIGHTING AND POWER NOTES.

Acton.—The U.D.C. has resolved to undertake the free wiring of premises up to £50 in value upon a three years' agreement, with 10 per cent. on the outlay, and Messrs. L. Hermes & Co., of Ealing, have been appointed contractors under the scheme. The Council is also introducing prepayment meters, upon a charge of 6d. per unit. A monthly prepayment system is also to be adopted.

Barking.—The past year's working of the U.D.C.'s electric lighting undertaking has yielded a net profit of £114.

Barnstaple.—The T.C. has resolved to apply to the L.G.B. for sanction to borrow £4,000 for electric light purposes.

Belfast.—The electrical engineer to the City Council has recommended that an alternative flat rate of 4½d. per unit, should be adopted. The following charges in connection with the rate for power are also advised:—2½d. and 1d. under 2,000 units per quarter; 2½d. and 1d. 2,000—5,000 units; 2d. and 1d. over 5,000.

For the year ended March 31st last the E.L. department report a revenue of £28,141, and an expenditure of £11,157, leaving a gross profit of £16,984. After deducting interest and sinking fund, £4,357 remains as net profit.

Birmingham.—The Electric Supply Committee of the City Council, in its annual report, states that the number of units sold during the year was 4,645,027, compared with 4,367,164 units in the previous year. The revenue account shows a credit balance of £39,573, as compared with £36,939 for the previous year. The total working costs were 1·584d. per unit, against 1·742d. in the preceding year. The net result of the year's working, after paying interest and sinking fund charges amounting to £28,784, was a surplus of £10,789, compared with £10,412 in the previous year. The total length of new mains laid during the year was 11,050 yards, and the lamp and motor connections were equal to a net addition of 16,168 16-c.p. lamps.

Blackburn.—The report of the Corporation electricity department for the past year states that the gross profit was £14,548, and the net profit £252, which has been transferred to the reserve fund, increasing it to £1,228. In the previous year the net profit was £1,634.

Continental Note.—Germany.—The municipal authorities at Altona (Elbe) have resolved upon the erection of an electric lighting plant in the town.

Dewsbury.—On May 24th a L.G.B. inquiry was held relative to the application of the T.C. for a loan of £10,000 for E.L. and power purposes. There was no opposition.

Durham County.—The Durham R.D.C., similarly to the Chester-le-Street R.D.C., having consented to the use of overhead high-tension and distributing mains for the supply of energy by the County of Durham Electrical Power Distributing Co., the latter has agreed to supply private users at 3¾d. per unit less 5 per cent.

Exeter.—It is recommended that the sum of £1,217 be transferred from the reserve fund to the past year's net revenue account, in order to provide a sum sufficient, with the balance of that account (£425), to pay the sinking fund charges on the sum of £68,385 for the year ended March 31st, 1905, which amount to £1,642.

It is also recommended that a further sum of £5,478 be transferred from the reserve fund in order to discharge the unsanctioned loan expenditure in respect of machinery and building extensions in New North Road.

Exmouth.—The Electric Supply Co. has reduced its charge for electricity to 5d. per unit.

Gloucester.—The annual report of the City electrical engineer, Mr. W. J. Bache, M.I.E.E., was presented at a meeting of the City Council on Tuesday. The report stated that 71 new consumers had been added, and the number of 8 c.p. lamps connected was 37,276, an increase during the year of 8,378. The capital expended on the undertaking has increased from £67,275 to £75,240, and this is almost entirely on account of the light railways plant. The amount set aside for interest and sinking fund is £797 higher than in the preceding year, and is just under 6 per cent. on the capital. The total expenditure on revenue account, apart from financial charges, is £4,872. The average cost of generation and distribution has largely decreased owing to the increase in the number of units sold. Last year the average cost per unit was 1·68d., and it has now fallen to ·997 of a penny. The revenue of the undertaking amounted to £10,409, and the gross profit to £5,537, or 7½ per cent. on the capital outlay. Financial charges rose to £4,449, leaving a net profit of £1,089, which is to go to reduce the accumulated deficit of £1,859. There should be no difficulty in entirely wiping this deficit out next year.

A L.G.B. inquiry was held recently into an application by the City Council to borrow £12,100 for extensions at the electricity works, consisting chiefly in the enlargement of the station and the installation of three new boilers and other plant.

Hull.—The Corporation E.L. Committee has decided to let out motors on hire, the annual rental to be 15 per cent. of the outlay.

The report of the past year's working of the Corporation electricity undertaking shows that there are 2,452 consumers connected, being an increase of 185 during the year. The number of units sold per 8-c.p. lamp have fallen slightly. The gross receipts during the past year amounted to £39,867, and the expenditure to £17,167, the balance being £22,700, and the net profit £4,980. Negotiations have been completed with Messrs. Reckitt & Sons for supplying them with energy in bulk.

Ladybank, N.B.—Application has been made by the T.C. to a local manufacturing firm, who possess an electric light plant, for a supply of energy for the town, but the capacity of the local plant proves insufficient for the purpose.

London.—Islington.—The report of Prof. Kennedy on the proposed extension of plant at the electric lighting station states that an extension is desirable, and that it ought to be carried out as soon as possible. The boiler power is sufficient; but a new a.c. generating set is required with condenser, piping, &c. Prof. Kennedy expressed the opinion that advantages rested with the adoption of a turbo-machine. Upon this report the Electricity Committee has again forwarded its estimate of £15,500 to the Finance Committee, and it has been reported that the latter has adopted same.

Poplar.—An L.C.C. loan of £3,345 for boiler, machinery, &c., for the electricity undertaking, and £315 for meters is to be taken up by the B.C.

Westminster.—The General Purposes Committee has decided (subject to the usual sanction) to enter into a three years' contract with the electric supply companies in the area, for a supply to public buildings at 2½d. per unit for lighting, and 2d. per unit for power, on condition that the Council shares any reductions in price made to consumers. A letter has been received from the B. of T. with reference to a communication from the Council on the subject of the additional system proposed to be adopted by the London Electric Supply Corporation for the supply of energy under their orders. The B. of T. has informed the Council that street fuses are necessary for securing the safety of the public, and the continuity of supply, and pointing out that the Board has not power to direct that access shall be given to street fuses from private property. The Board further considered that it would be advantageous if the fuses were placed in pillar boxes, but the Council considers the latter would obstruct the streets, and has replied accordingly.

Hampstead.—The working of the electricity undertaking for the year ending March 31st last, shows a net profit of £8,327. £2,000 of this is to be applied to the relief of the rates, and the balance is to be transferred to the reserve fund. Last year the profit was £4,722, all of which was carried to reserve. In 1904-5 the income was £62,625, and the expenditure, exclusive of payment of interests, and instalments of loans, £27,982.

Luton.—The L.G.B. has sanctioned the borrowing by the T.C. of £5,000 for E.L. purposes.

The financial statement with regard to the undertaking states that the profit, after payment to sinking fund, &c., amounts to £270; £201 has been refunded to the District Fund, and £69 carried to reserve.

North British Railway.—The N.B.R. Co. has for some time been applying electricity for the lighting of the signals on a portion of its system. So successful has the lighting proved that the company intends extending its use, commencing with the Waverley Station in Edinburgh.

The lamp and fixed bracket, which is to be adopted, will cost about half the outlay on an oil lamp, and dispense with the winding apparatus. Lampmen are not required, so that there will be a saving in wages besides store accommodation. Mr. J. Primrose, chief electrician of the railway company, has the work in hand. We think other railway companies might, with advantage, adopt electricity for signal lighting.

Salford.—Representative Committees of the Manchester and Salford Corporations are still engaged on inquiries regarding the possible advantages of municipal federation. The electrical undertakings of the city and borough were considered by the Salford Committee at its last meeting, and unification of the two undertakings, it was argued, would result in a large decrease in the cost of administration. It was stated by the chairman of the Finance Committee, at a meeting of the B.C. last week, that the Electricity Committee purposes contributing a sum of £7,500 (£3,000 more than last year) in relief of the borough rates, and the Tramways Committee £13,000, the same as before.

Somerset.—At Bridgetown recently, an E.L. supply was inaugurated. According to a local report it is the smallest centre with an electricity supply, there being less than a score of houses in the district.

South Africa.—Klerksdorp.—The question of lighting the town by electricity is now being considered by the T.C.

South Shields.—The annual report of Mr. J. H. Cawthra, the electrical engineer for the borough, has just been issued. From this it appears that the capital expenditure now amounts to £151,838. The gross income for the year was £18,132, an increase of £967, as compared with the previous year; the total working expenses amounted to £6,935, an increase of £300, leaving a balance of £11,196. From this must be deducted interest on loans. £4,899 has been set aside to interest, and £4,231 to sinking fund, a net balance remaining on the year's working of £2,065. The sum of £77 had also to be deducted, representing loss on Holborn Quay, reducing the balance to £1,988 as compared with £1,603 at the end of the previous 12 months. The number of units sold to consumers was 1,385,393, an increase of 86,104. There are now 1,117 consumers as compared with 1,010 a year ago. The electrical engineer states that the works costs on an output of 1,385,393 units were ·61d. per unit, and therefore it could claim to be the third lowest of all electrical undertakings in the kingdom, either company or municipal, supplying electric energy for lighting and power purposes only. The engineer draws attention to the abnormally low figure at which the reserve fund stands—£2,491—and he strongly recommends the Committee to place the whole of the balance to reserve fund.

Swinton and Pendlebury.—On May 25th a L.G.B. inquiry was held with reference to the U.D.C.'s application for a loan of £12,300 for electric purposes. It was explained that by agreement with the Lancashire Electric Power Co. the latter would be the contractors under the Council, and when the profits accrued to a sum equal to the losses experienced in the early years of the undertaking it should belong to the Council. The present definite demand amounted to 70 kw., and other applications amounted to an additional 125 kw. It was proposed that the company should supply energy in bulk.

Walsall.—On May 24th a L.G.B. inquiry was held into the application of the T.C. for a loan of £1,350 for electricity purposes. There was no opposition.

Walthamstow.—At the expiration of the present contract with Messrs. Henley, the electrical engineer is to undertake for the U.D.C. the carrying out of house services and connections.

Welshpool.—At a meeting of tradesmen on May 24th it was decided to ask the Mayor to call a meeting of ratepayers, to consider the advisability of the Corporation undertaking the introduction of electric lighting.

Wishaw.—The total amount to be expended on the electric light installation for the town is £12,653, and the price to consumers has been fixed at 3½d. per unit. In the streets 45 10-ampere arc lamps and 33 90-c.p. glow lamps are to be erected.

TRAMWAY AND RAILWAY NOTES.

Baldwin - Westinghouse Single-Phase 1,500-H.P. Locomotive.—During the visit of the delegates to the International Railway Congress to the Westinghouse Works at Pittsburg on May 16th, a great deal of interest was manifested in the new 1,500-h.p. Baldwin-Westinghouse single-phase alternating-current electric locomotive in use on the Westinghouse Interworks Railway. This locomotive has just been completed by the Westinghouse Co. and Baldwin Locomotive Works, and is in two parts, connected and controlled by the unit-switch system. The weight of the locomotive complete (both halves) is 135 tons, and the total length over buffers is 45 ft. The maximum height with trolley down is 17 ft. The drivers are 60 in. in diameter, and the distance between centres of drivers is 6 ft. 4 in. The extreme width of the locomotive is 9 ft. 8 in. The locomotive is equipped with six single-phase, single-reduction geared motors, having a normal capacity of 225 h.p. each, with gear reduction of 18 : 95. Induction regulator control is used, with a pneumatically-operated trolley. The air-brake equipment is combined automatic and "straight air," with pneumatic sanders to sand tracks in both directions. The locomotive is designed to operate with 3,600 volts on the trolley wire, and with a voltage of 140 to 320 on the motors. The locomotive has a draw-bar pull of 50,000 lb. at a speed of approximately 25 to 30 m.p.h.

Belfast.—The Committee has accepted the tender of the Brush Co. for the erection of the generating plant in the Chapel Lane station. This is for supplying power to the Falls Road system for the instruction of motormen before the ordinary service is ready. The electrical engineer was instructed to obtain local tenders for tower wagons, and permission was given to obtain two motor instructors to teach the drivers.

Birmingham.—The Tramways Committee reports a gross profit of £6,784 on the Steelhouse Lane route, and, after providing for interest and sinking fund, a net profit of £5,800 remains, which has been carried to reserve. The electrification of four other routes is to be taken in hand at once.

Blackburn.—The municipal tramway undertaking last year yielded a gross profit of £18,295. The net loss was £2,793.

Bolton.—The Corporation Tramways Committee, on May 25th, decided to allocate £3,000 of the profits in aid of the rates. This is in addition to £940 already granted.

Bombay.—The Bombay Corporation has at last come to a conclusion respecting what shall be done about the tramways in the city, after fighting an existing tramways company for some three years in the law courts on the subject of goodwill, depreciation, &c. It is now decided that the whole tramway system is to be handed over to the Brush Electrical Engineering Co. for conversion into an electric traction system, in about three months' time. Several miles of new lines are to be constructed immediately, and there is some talk of providing two classes of cars, respectively for British and Indian passengers. The Bombay Corporation possesses the right of purchase at the expiration of the following periods:—42 years, in which case 40 lakhs of rupees is to be paid for goodwill; 56 years, in which case 20 lakhs is to be paid for goodwill; 63 years, and periodical intervals of 7 years afterwards, in either of which cases nothing whatever is to be paid for goodwill. The Brush Co. is to register a new company called the "Bombay Electric Supply and Tramways Co.," which is to have at its disposal the sum of £1,000,000 sterling. This sum is said to have been guaranteed in London. The new company (to be registered in Bombay) will assume all contracts and liabilities entered into between the Brush Co. and the Bombay Corporation as regards completing the purchase of the existing tramways, their conversion to electric traction, and the completion of certain extensions.

Bradford.—At the meeting of the Tramways Committee on Monday, it was reported that there was a profit of £70,000 on the tramways undertaking, and, after allowing for sinking fund and interest, there remained a disposable balance of £16,000. This, the largest balance which the Committee has had, is partly due to the Exhibition.

An interesting case is occupying the Bradford courts. John Wilkinson has been summoned for failing to show his ticket on an electric car when requested to do so. He did not show it, and refused to pay the fare. The stipendiary magistrate drew attention to a Sheffield appeal in a similar case. The Bradford case stands adjourned.

Continental Note.—Italy. La Societa delle Ferrovia Elettrica di Valle Brembana has secured a concession to put down a plant to utilise the water-power of the River Brembo in the generation of electrical energy for traction purposes.

Darlington.—Darlington must be added to the number of small municipalities which cannot make tramways pay under any circumstances. Halfpenny stages have now been in force for a month, having been put into operation during the week ending May 6th, and while they show an increase in the number of passengers carried as compared with the corresponding period last year, the receipts, amounting to £779, have decreased by about £100, and this in spite of the fact that, owing to local circumstances, the traffic on several days of the month was abnormal, on five days between 7,000 and 8,000 passengers above the daily average being carried per day. With a loss of £2,629 (exclusive of the heavy item of depreciation) on the working of the Municipal Tramways for the year ending March 31st last, the committee is aghast at this latest result, which is nothing less than disastrous. The committee had rightly decided against half-penny stages, but at the full meeting of the Council, at which three members of the committee were not present, this decision was ignored and the introduction of halfpenny stages was carried by the casting vote of the Mayor. The loss to the town, with a population of 50,000, is equal to a rate of more than 5d. in the £. Some ultra-municipal faddists seem to think that the nearer they can come to a free tramway service, the greater will be the profits.

Doncaster.—The plebiscite taken recently on the question of running the electric tramcars on Sunday, resulted in a majority of 972 against the proposal.

Eccles.—The Eccles, Monton and Peel Green circular tramway route will be opened for traffic on June 1st. The construction of the lines has involved the building of a new steel girder bridge over the Bridgewater Canal, at a cost of £7,000.

Folkestone—Hythe.—At a meeting of the Hythe T.C. on May 24th, a letter was read from the National Electric Construction Co. with reference to the proposed electric tramways between Folkestone, Sandgate and Hythe, to be worked under the control of the local authorities. At the same meeting a letter was received from the town clerk of Folkestone, suggesting that a conference on the tramways question between representatives of Folkestone and Hythe Corporations and Sandgate and Cheriton U.D.C.'s should be held. United action was strongly supported, and it was decided to fall in with the wishes of Folkestone.

Glasgow.—The Tramways Committee has been considering the best means to adopt for protecting car drivers during inclement weather. One of the suggestions consists of a glass shield, the windows of which can be kept open or closed; this was fitted on a car at Coplawhill, and examined by a sub-committee. Another suggestion made is for a canvas frame similar to that in use on the bridges of steamers. The proposal, however, which finds most favour, is to provide the men with leather jackets similar to those worn by the drivers of motor-cars. The decision of the Committee has been delayed until the return of Mr. Dalrymple, the manager, from Chicago.

The Tramways Committee of the T.C. has recommended that the work of constructing the tramways to Balgrayhill, Baillieston,

Dumbreck and Barlennie, authorised by the Glasgow Corporation Tramways Consolidation Order of the present Session, should be proceeded with.

A special sub-committee of the T.C. has been appointed to confer with the T.C. of Clydebank with regard to the widening of bridges consequent on the proposed extensions of the tramways within the latter burgh.

Germany.—Electric traction is to be adopted on the tramways in Bremerhaven.

London.—L.C.C.—The Highways Committee reminded the Council of the refusal of the Standing Orders Committee of the House of Commons to allow the insertion in the Council's Tramways Bill of the present Session of a clause seeking express authority in connection with the reconstruction of tramways, to lay raised temporary tracks, and to maintain car services thereon during reconstruction. Having regard to the opposition to the proposal, the Standing Orders Committee recommended that the standing orders should not be dispensed with, and the recommendation was agreed to by the House of Commons. As the matter was of such great importance to the Council, the Committee thought that, to safeguard its position, it would be wise to seek the necessary authority in the next Session. On the recommendation of the Committee, the Council resolved to seek express authority in the session of 1906 for the purpose in question. An expenditure of £7,150 was sanctioned for the erection of a sub-station at Streatham, this sum not including the wiring and fitting of the building.

The Council postponed for a week the consideration of a report by the Highways Committee, recommending the approval of estimates amounting to £287,150 for the construction of various authorised tramways on the conduit system, and the obtaining of tenders for the execution of the work, so as to be completed and equipped ready for working soon after the opening of the first section of the Greenwich power station. The tramways, which represent a total length of about 17 miles of single line, are as follows:—(1) From Camberwell Green, *via* Denmark Hill, Champion Park, Grove Lane, Dog Kennel Hill and Grove Vale, to the junction of Lordship Lane and Crystal Palace Road; (2) from the terminus of the authorised tramways in Lordship Lane, *via* Lordship Lane and London Road, to Dartmouth Road, Forest Hill; (3) from Grove Vale, *via* Goose Green, East Dulwich Road and Peckham Rye, to Stuart Road, Peckham; (4) from the existing L.C.C. tramways in New Cross Road, *via* Lewisham High Road, Loampit Hill and Vale, and High Street, Lewisham, to Rushey Green; and (5) from the existing L.C.C. tramway terminus in Trafalgar Road, Greenwich, *via* Blackwall Lane, to a point near Blackwall Tunnel. The expenditure of £287,150 does not include the cost of street widenings, which mean an additional sum of £120,000. It was estimated that the lines would yield a surplus of receipts over expenditure amounting to £21,810 per annum. In commenting upon the scheme, the Finance Committee expresses the opinion that the Council should postpone any further large tramway projects until the tramway works to which the Council is committed are completed and have become revenue producing.

Manchester Suburbs: Proposed New Electric Railway.—A company is being promoted for the construction of a light electric railway to connect the outer suburbs of Manchester. It is proposed that the line (which will be for both passenger and goods traffic) shall intersect and connect all the existing southern trunk lines from Manchester to London. There will be a new centrally situated terminal station on the south side of Manchester, from which the line will run in a south-westerly direction into Cheshire for about seven miles, and continue through the outer belt of North Cheshire residential districts within an average radius of nine miles from the Manchester Town Hall, finishing at Hazel Grove, near the Stockport Corporation Tramway terminus and the Midland Railway station. The line will be three miles, or so, outside the existing and authorised suburban electric tramway routes. The promoters claim that it will possess the exceptional advantage of security from future competition by electric tramways or motor-omnibus services on the highways, as there are no existing suitable roads serving the districts in question which could be utilised for either of these forms of traction. A meeting of persons interested is to be held in Manchester during the first week in June, when engineers' plans will be submitted, with the view of showing what degree of local support would be given to a Bill in Parliament.

Newcastle-on-Tyne.—The new double-deck covered cars which have been tried by the Corporation have proved very popular, and the Tramways Committee has decided to order twenty-two more cars of a similar type.

St. Helens.—During the week the number of cars on all sections of the system at St. Helens has been increased. On Friday four cars were placed on the Haydock section, which had been entirely neglected for four weeks. It had been previously remarked that the sympathies of the Haydock residents were evidently in favour of the strikers, and that there was likely to be some disorder when the service recommenced. On Friday night all the four cars were stoned for a considerable distance along the road, and sustained damage. The company's officials stated that they caught one of the strikers in the act of throwing, and that he would be proceeded against. The cars running in St. Helens borough were, for almost the first time since the strike commenced, entirely unmolested.

Ramsgate.—On Friday last an electric car was descending a steep hill when apparently the brakes failed to act; the car ran with great speed to the bottom, and dashed into a grocer's shop. The shop was wrecked, and some of the lady passengers were thrown amidst the broken glass and showers of falling jars. A little girl, the daughter of the manager of the shop, was removed from under the tram with her skull fractured, and the driver of the car received head and chest injuries. The conductor was also removed to the local surgery with his right cheek and scalp cut very badly. A number of other injuries of a less serious character were received by passengers.

Widnes—Runcorn Transporter Bridge.—After the formal opening of the bridge on Monday, about 13,000 persons were transported across the Mersey in the travelling car. On Tuesday morning, about 10 o'clock, the working of the bridge was suspended for some hours owing to some adjustment being found necessary in the machinery.

The whole of the electrical plant was supplied by Messrs. Mather and Platt, Ltd.; the motive-power is obtained from two Crossley gas engines of 75 B.H.P. each, running on Widnes town gas. There are two Mather & Platt 48-KW. dynamos directly coupled to the engines, and a battery of 245 Chloride cells. The car is driven by two 35-B.H.P. enclosed motors, controlled from a cabin on the top of the car.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—According to advices received by the mail delivered in London on Monday, the Federal authorities, after giving close attention to the information supplied by Mr. Hesketh, as a result of his visits to the United States and Europe, to the Conference of Deputy Postmaster-Generals, have decided that the automatic telephone is not suited to Australian requirements. The Conference regarded the mechanism as too complicated for the subscriber, and generally adopted a cautious attitude towards it. "There are limits to the satisfactory use of the condenser method of adapting telegraph lines to telephone purposes." This is the verdict of a recent conference of departmental electrical experts held in Melbourne; but the Postmaster-General expects to find the condenser system very useful where the volume of traffic is small, and the distance between the points connected is not beyond a certain maximum. For very long distance work it has been found that it cannot be relied on, a fact that was demonstrated by a breakdown early in the year in the attempted linking of Hamilton with Melbourne *vid* the condenser apparatus.

Canadian Telephones.—According to a correspondent of the *Morning Post*, the principal witness before the Telephone Committee of the Dominion Parliament last Friday was Mr. H. L. Webb, of London. He declared that Government ownership of telephones in Great Britain was proving a failure, while the system in use in Glasgow was one-third obsolete. The statements of Mr. Webb made a considerable impression on the Committee.

Empire Cables.—In Friday's Parliamentary Papers, Mr. Charles Devlin asked the Postmaster-General whether the resolutions adopted by a number of Chambers of Commerce of the Empire respecting Empire cables had been brought under his notice; and if he intended submitting, at the Colonial Conference of 1906, any scheme or policy with respect to Empire cables. Lord Stanley, in reply, said that recent representations on the subject had been addressed to him, and he did not feel called upon to submit to the Colonial Conference any scheme of the kind suggested.

Kustendji-Constantinople. — SUBMARINE CABLE.—We read in the *Times* that the German steamer *Von Podbielski* began to lay this cable on the 29th ult.

Shanghai.—The *Standard* states, in connection with the report that the cable between Chifu and Shanghai had been cut, that the cable, though interrupted, has not been cut; as a cable-repairing steamer is in the neighbourhood, the service will be restored shortly. It is further pointed out that, as the Chifu-Tsingtau cable was interrupted on May 23rd, there is at present no cable communication between Chifu and Shanghai.

Westminster Telegraphs.—The Engineer-in-Chief of the General Post Office writes, with reference to the Council's notification that it does not accept responsibility for any lack of ventilation in the footway and roadway boxes, that the Department recognises that the Council cannot take any such responsibility. He suggests that the only means of ventilating boxes without risk of explosion are ventilating pillars, drawings of which he will be pleased to submit if the Council is prepared to favourably consider the question of fixing such pillars in the footways. The Works Committee of the Council having discussed the foregoing, has decided to reply that it does not see its way to entertain any proposal for the erection of ventilating pillars on the public highways of the City.

(*Continued on page* 902.)

THE ELECTRIFICATION OF THE METROPOLITAN DISTRICT RAILWAY.

The electrification of the "District"—to give it its more familiar designation—is now an accomplished fact. For some considerable time the vicissitudes of this, London's main artery of railway communication, have been prominently before the public, and we do not propose to trouble our readers with a lengthy account of them.

The Metropolitan District Railway undertaking dates back to 1868, and its present route mileage, after successive extensions and inclusive of running powers, amounts to some 56 miles.

Of late years it had become increasingly apparent that its traffic-carrying capacity under the old steam conditions had reached a practical limit, and this, combined with ventilation and overcrowding troubles, rendered the adoption of some such system as the present, an absolute necessity.

In 1897 the company took the first practical step towards electrifying its line, by obtaining the necessary Parliamentary powers for that purpose, and also for constructing a tube line under the present route from Earl's Court to the Mansion House.

Subsequently, in conjunction with the Metropolitan Railway Co., who were also interested in possible electrical developments, some ¾ mile of route between Earl's Court and Kensington High Street Stations were experimentally equipped, with satisfactory results. An illustrated description of this line appeared in the Electrical Review, May 25th, 1900.

In 1900 the company obtained further Parliamentary powers, and in 1901 the Joint Metropolitan and Metropolitan District Railways Joint Committee decided on the adoption of the Ganz three-phase system of traction on the "Inner Circle" portion of the route.

With the advent of Mr. Charles T. Yerkes into the London railway world, and the events which led up to the discarding of the original scheme for the well-tried direct-current system, our readers are familiar; and it is sufficient to state that a uniform direct-current system, including the provision of both power and return rails in addition to the ordinary track rails, was adopted by the two companies concerned. The question of power supply for the working of the railway, was solved with the creation of the Underground Electric Railways Company of London, Ltd., which, in addition to electrically equipping the District and certain tube railways, with which it is associated financially, also undertook to erect a large central power station at Lot's Road, Chelsea, from which to supply energy, at an agreed price, to the several railway companies, whose route mileage amounts to some 75 miles.

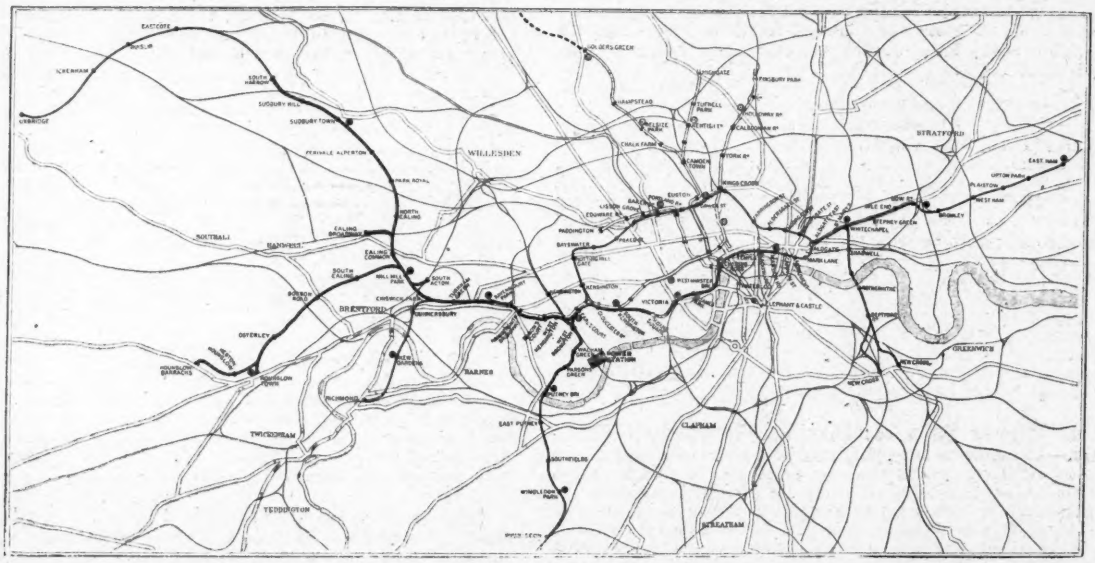
The problem of dealing successfully with a traffic amounting to some 50 million or more passengers per annum, even under the new conditions, will be no mean task, and whether the essential factors in suburban travelling, of comfort and speed, be attained to the extent anticipated or not, the electrified District, on account of its easy access and more favourable conditions, is sure to be increasingly favoured as a means of transit by the travelling public.

With the supersession of the only too familiar steam trains, electrical trains will be introduced each consisting of seven coaches, three motor-coaches and four trailers, the former being disposed at the ends and centre of the train. Altogether some 60 trains, built to similar designs, are being supplied by the Brush Electrical Engineering Co., the Metropolitan Amalgamated Railway Carriage and Wagon Co., and certain Continental makers.

The coaches adopted on the District Railway are principally constructed of pine and ash, with mahogany framing, the whole of the woodwork being rendered non-inflammable by a special process.

Partitions are provided at the ends of the passenger compartment, formed of ¼-in. mild-steel plate, a centre opening being left for a doorway.

The end motor coaches are provided with a luggage compartment, and a collapsible cab of neat design is arranged in one corner for the motor man; the centre motor coaches are similar in design to the trailers, being provided with short vestibules, not unlike the arrangement in modern dining cars, and the control apparatus can be entirely enclosed by means of a door which swings through an angle of 180°, and which in its middle position, where it can be locked, divides off a portion of the vestibule for the motorman. Views of the control apparatus, open and enclosed, are shown in figs. 5 and 6.


EASTCOTE
RUISLIP
ICKENHAM
UXBRIDGE
SOUTH HARROW
SUDBURY HILL
SUDBURY TOWN
PERIVALE ALPERTON
WILLESDEN
GOLDERS GREEN
HAMPSTEAD
HIGHGATE
FINCHLEY ROAD
CHALK FARM
EUSTON
KINGS CROSS
STRATFORD
EAST HAM
PLAISTOW
WEST HAM
BOW RD
MILE END
STEPNEY GREEN
WHITECHAPEL
BROMLEY
NORTH ACTON
EALING BROADWAY
SOUTH EALING
NORTHOLT
HANWELL
BOSTON ROAD
BRENTFORD
CHISWICK
OSTERLEY
HOUNSLOW BARRACKS
HOUNSLOW TOWN
HOUNSLOW WEST
SOUTH ACTON
MILL HILL PARK
PADDINGTON
BAYSWATER
LANCASTER GATE
MARBLE ARCH
HYDE PARK CORNER
VICTORIA
SLOANE SQUARE
SOUTH KENSINGTON
GLOUCESTER ROAD
WEST BROMPTON
EARLS COURT
WEST KENSINGTON
ADDISON ROAD
BROMPTON ROAD
KNIGHTSBRIDGE
SLOANE STREET
SOUTH KENSINGTON
MUSEUM
CHARING CROSS
EMBANKMENT
TEMPLE
BLACKFRIARS
MANSION HOUSE
CANNON STREET
MONUMENT
TOWER HILL
ALDGATE
ALDGATE EAST
WHITECHAPEL
MARK LANE
FENCHURCH STREET
CROMWELL ROAD
GLOUCESTER ROAD

It is the intention that cars shall be simultaneously loaded from the end, and unloaded from the centre doors.

The doors are operated by compressed air, supplied from the brake equipment; the levers for actuating the doors (on either side) are fixed on the exterior end panels of the cars, and when closed or opened the doors are automatically locked and unlocked. The above arrangement is, we believe, peculiar to the District Railway, for whom it has been specially designed.

Externally the cars are sheathed with aluminium and painted a bright scarlet, a somewhat unique departure in English railway practice.

The cars are fitted with vertical type automatic couplers and cast-steel buffers, provided with horizontal corrugations, the latter serving to interlock the cars in case of collision, and, together with the steel bulkheads, tending to minimise the risks of telescoping.

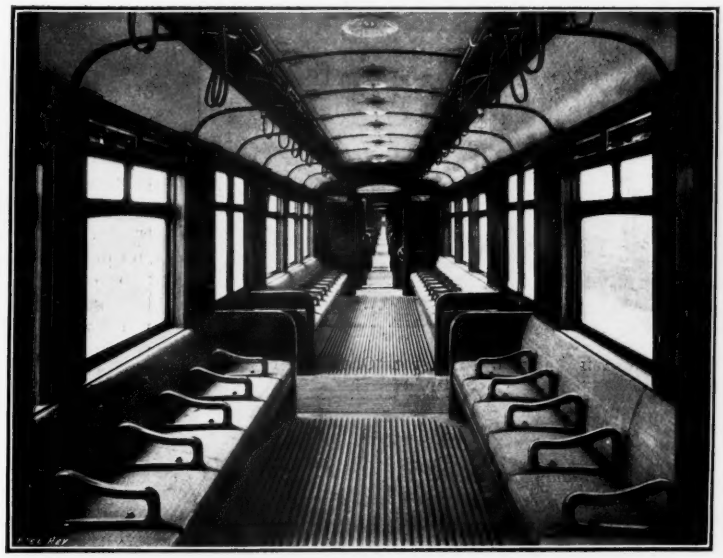


Fig. 2.—Interior of Electrical Train.

Each car is provided with a standard Westinghouse automatic air-brake equipment, including Christensen motor-driven air compressors, and two independent air-brake pipe lines run the length of each train.

The electrical equipment for the whole of the trains has been supplied by the British Thomson-Houston Co., Ltd.; each motor-car being fitted with two 200-h.p. G.E. 69 motors and the Sprague-Thomson-Houston multiple unit train control, which includes a series of contactors fitted under the car, and a master controller installed in the cab for operating the contactors, not only on that car, but throughout the train, and thus affecting the various electrical combinations of the motors.

The motors are arranged with a nose suspension, and the gear is divided into two halves with a 7-in. bore, arranged to go directly on the axle. The weight of one motor complete, together with the gearing and gear-case, is about 6,100 lb.

The multiple unit train control adopted on the District coaches does not greatly differ from previous equipments, as described in the Electrical Review, December 13th, 1901, and February 26th, 1904.

The controller provides four rheostatic points and one running point in series, and three rheostatic points and one running point in parallel, and it is interesting to note that these trains are the first in England to use the "bridge" method of changing from series to parallel combination of the motors. By this method the change is effected without interrupting the current in either motor and the unpleasant sag in speed, which is noticeable when the motor current is interrupted, is thus eliminated.

Another new feature is an electrically-operated carbon break circuit-breaker, fitted for the protection of the motor circuit on each motor-car; all the circuit-breakers may be instantly tripped, by merely closing a tripping switch in the cab, and any circuit-breaker may be opened automatically through an overload in its motor circuit, without affecting the remaining circuit-breakers in the train.

Fig. 3.—Seven-Coach Electrical Train, District Railway.

Magnetic blow-out ribbon type fuses are inserted in all the main circuits, and are mounted beneath the car.

The control cable consists of 10 different coloured separately insulated conductors for convenience in installation, and is used for the several multiple circuits between couplers, connection boards, master controller and cut-out switch.

The controlling apparatus, air compressors and governors which are used for the brake apparatus, are supported beneath the car, between the trucks. The main wiring is enclosed in drawn steel tubes, and the rheostat and contactor leads are supported in wooden troughs lined with uralite. The motor leads are protected by flexible metallic covers, each length of which is brazed into a brass plug tapped into the motor frame, and the two motors also are provided with suitable connection boxes, in which the motor leads are connected to the car wiring.

FIG. 4.—CENTRE MOTOR COACH, SHOWING CONTACTORS OPEN TO VIEW.

Each car is lighted with some 35 16-C.P. glow lamps, energised from a lighting cable running through the train and connected to the main supply.

The principal car depôt and repairing shop of the company, which is situated at the side of the railway, midway between Mill Hill Park and Ealing Common Stations, is illustrated on page 899.

FIGS. 5 AND 6.—DRIVER'S CAB; CONTROL APPARATUS OPEN, AND ENCLOSED BY MEANS OF SWING DOOR.

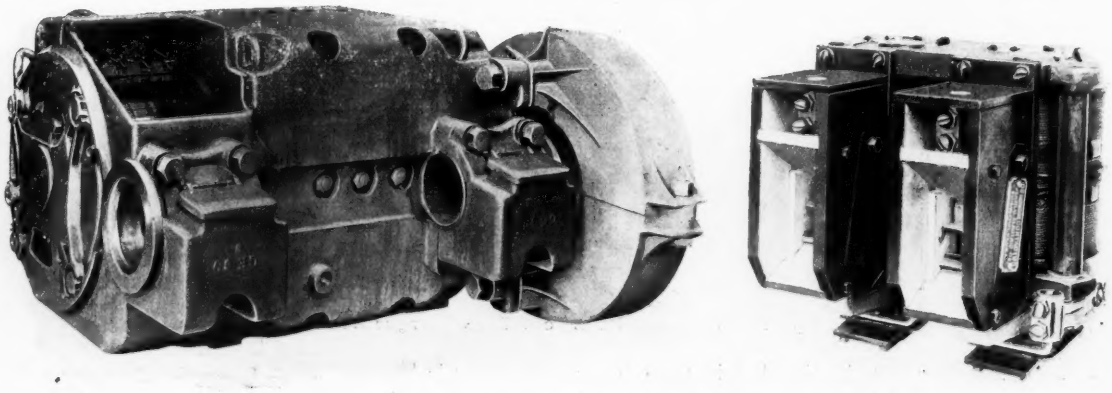
The buildings are 800 ft. long and 216 ft. wide, constructed in steel and brickwork, and arranged in three long bays, containing in all 11 tracks, each of which will accommodate two seven-coach trains. In addition to this, accommodation for some 200 cars is provided on the sidings.

The bay farthest from the railway contains only two tracks, the remaining space being very completely equipped as a repairing and erecting shop, where, in fact, the whole of the new stock is being received in sections and fitted up under the direction of Mr. F. D. Ward, of the Underground Electric Railways Co., to whose initiative many of the new constructional features are due. The machine shop is well illustrated in fig. 10.

The centre bay, containing five tracks, is utilised for repairing motor equipments, and is provided with two overhead travelling cranes, for lifting cars when necessary; the bay nearest the railway contains four tracks only, and is used for painting, &c., this shop being steam-heated from a Babcock & Wilcox boiler.

With the exception of those in the painting shop, all the tracks are provided with examination pits, and for the purpose of running the cars in the sheds, rigid overhead conductors, provided with small four-wheel trolleys, are fixed over each track; by means of flexible cables the trolleys can be coupled to the cars when it is desired to move the latter. Stores, offices, and a training school for drivers are also provided.

The permanent way, although it has involved an immense amount of construction work, does not call for special description; it is of standard construction, with the two-insulated conductor rails per track, added. The conductor rails are T-section, weighing 100 lb. per yard, made of specially low-resistance steel and mounted on insulators, which are in turn bolted to the sleepers. The positive rail is placed 16 in. outside and 3 in. higher than the running rail, the negative rail being placed in the centre of the track and 1½ in. above running rail.



FIGS. 7 AND 8.—STANDARD RAILWAY MOTOR AND CONTACTOR, DISTRICT RAILWAY.

Fig. 9.—Mill Hill Park Car Depôt and Repairing Shop.

"Crown" type bonds are used on the conductor rails, and the latter are sub-divided by independently-fed isolated train sections at the sub-stations and principal junctions; the latter arrangement ensures that energy shall not be cut off from two adjacent main conductor sections, in the event of an overload occurring, sufficient to operate the circuit-breakers.

Figs. 18 & 19 show the arrangement of the track-work at the complicated junctions at either end of Earl's Court Station, and are interesting as showing what can be accomplished with a power rail system.

In connection with the track, a passing reference to the cable work is necessary. A main cableway, consisting of 64 earthenware ducts laid in concrete, connects the power house with the railway at Earl's Court, which is approximately the nearest point. Passing through double distributing manholes where they join the railway, the cables which are practically all in duplicate, are carried on both sides of the track, either in earthen conduits or along the tunnel walls in special racks, as shown in figs. 16 and 17.

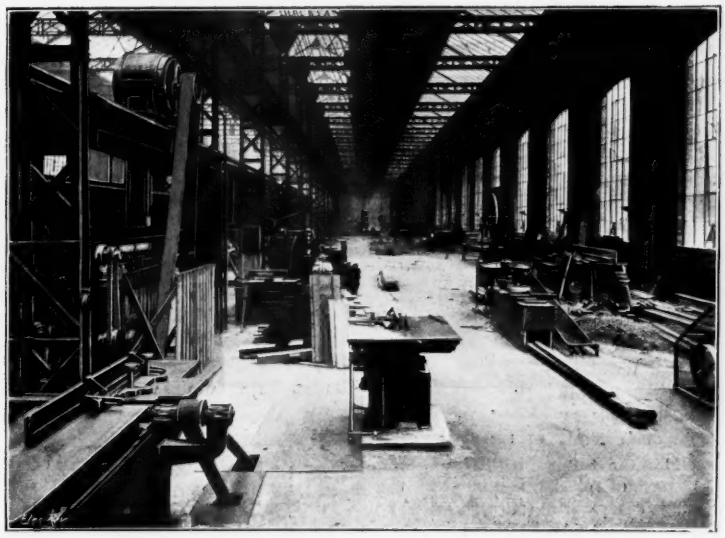


Fig. 10.—Interior of Machine Shop, Mill Hill Park Depôt.

It will be noted that as the duplicate feeders to any point are carried on opposite sides of the railway, the risk of complete breakdown is greatly minimised.

Altogether the cable racks on the city side of Earl's Court provide accommodation for 18 high-tension feeders on either side of the route, and the arrangement of the tunnel work generally, including the tunnel signals, will be gathered from the cross-section, fig. 16.

Every conductor rail in each section is connected by one L.T. feeder to a sub-station, the feeder terminal being attached to the web of the rail by three short flexible connecting cables.

In order to meet the conditions imposed by the more frequent electric train service, the Westinghouse electro-pneumatic system of automatic signalling and power interlocking has been installed practically throughout.

This system has been tested satisfactorily on the section of line between Hanger Lane junction and South Harrow, a distance of five miles, for over a year; it is, to a certain

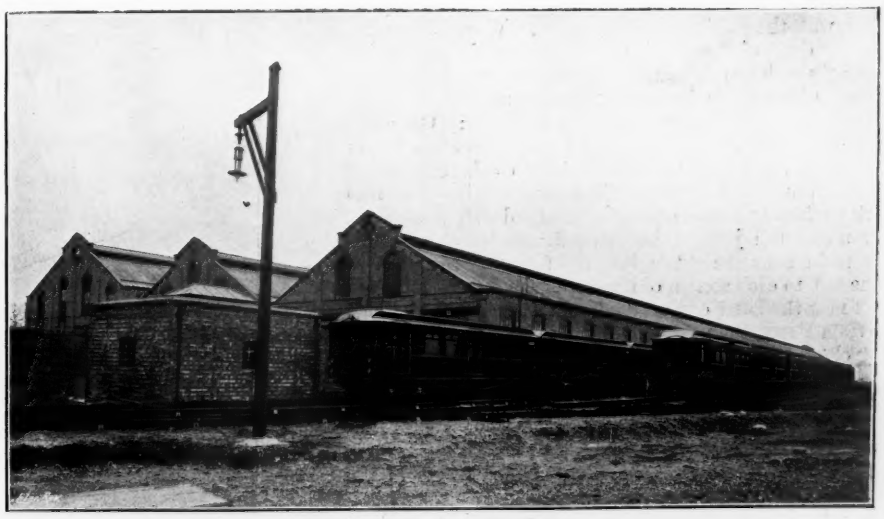
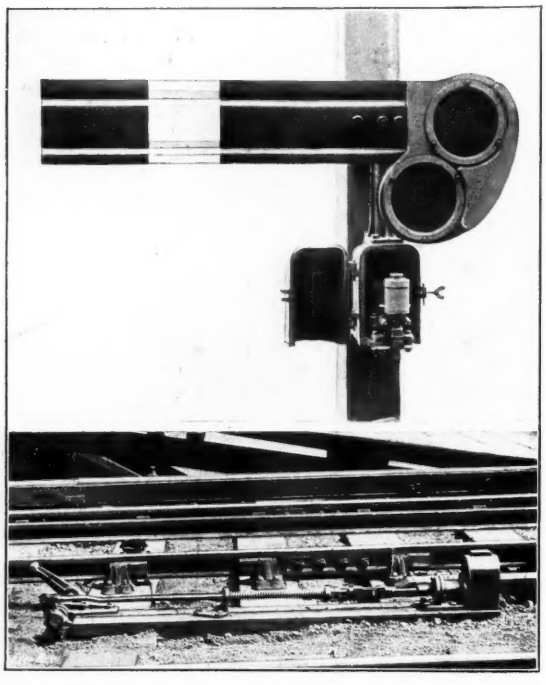


Fig. 11.—Car Depôt and Completed Electric Trains.



Figs. 12 and 13.—Electro-Pneumatic Signal and Automatic Train Stop.

extent, novel, having been designed to meet the special conditions obtaining on the District Railway. The space between stations is usually divided into two blocks, that is, a "starting" and a "berth" block, and the signalling is on the "normal clear" principle, compressed air holding the signal clear so long as its valve magnet is energised.

The present mechanical signals are being replaced by special arms with Westinghouse electro-pneumatic signal motors fitted close under them, and the ordinary counter-weight abolished for one directly on the signal arm, as shown in fig. 12. The motors are controlled by small pin valves, worked by means of electro-magnets in the local signal circuit. Signal cabins are required only at each end of a branch, or where there is a cross-over road; in the latter case they are normally closed, being opened only when required.

An automatic stop, fig. 13, prevents trains from overrunning home signals. This consists of an iron arm between the track rails, actuated by a compressed-air motor acting in unison with the adjoining signal motor. When the signal goes to "danger," this arm is elevated to a position in which it engages with a cock on the air-brake system of the train, through which the brakes are applied automatically.

The operation of the signal system is as follows:—One of the track rails is electrically continuous through the whole length of the track, and constitutes the positive conductor, feeding the individual track sections. The other rail is cut up into block sections by means of special insulated rail joints; all uninsulated rail joints being bonded. An insulated negative main runs the entire length of the system, and is connected to each section of the sectionalised track rail, at a point near the latter end of the block, *i.e.*, the end at which the train leaves, the potential difference being approximately 65 volts between the continuous—positive—rail and the insulated negative main.

Resistances are interposed in the connections between the negative main and the sectioned rail which reduce the potential difference between these rails to, in the present instance, from 3 to 6 volts, according to the length of the block and various local conditions.

In a block unoccupied by a train, current will flow along the continuous rail, and through the two relays, one at each end of the block, and ballast all in parallel, to the sectioned rail. From this it returns through a relatively large resistance to the negative main.

When a train enters the block, the relays are obviously shunted, with the result that the signal is allowed to go to danger.

The "track battery" resistances connected between the negative main and the sections of the sectionalised rail, prevent the generator from being short-circuited when the track circuit is shunted by the axles of the train; in fact, the shunting of the track cuts out only a small percentage of the total resistance of the circuit.

Fig. 14 is a diagram of the relay and signal magnet circuits for a single block. The track coils of the relays are permanently connected across the rails at that end of the block at which the relay is placed. Between the pole-pieces a polarised armature is suspended from a pivot. This armature bears a winding of considerable resistance, and is connected between the positive rail and the negative main through a contact—operated by the track coil armature—which is closed when the track coils are energised. To the polarised armature is rigidly connected, an arm which actuates a contact, the function of which is to open or close the local circuit controlling the signal motors. The operation of the relays is then as follows:—When a difference of potential exists in the normal direction between the rails—*i.e.*, when there is no train on the block—the relay track coils are excited and draw up the armature which closes the circuit through the polarised armature. The polarised armature is then attracted to one of the poles of the relay, and, swinging over, closes the contact in the local signal circuit.

The two relays in each block, operate normally in a pre-

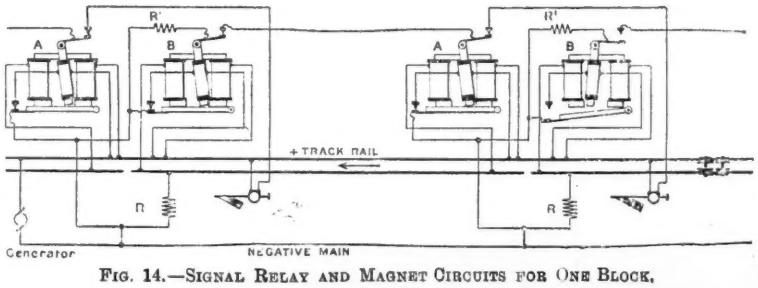


Fig. 14.—Signal Relay and Magnet Circuits for One Block.

Fig. 15.—Standard Signal Relay Box.

cisely similar manner, each working a contact in the local signal circuit. These contacts being in series, unless they are both closed, no current can flow through the signal magnet, and the signal will, therefore, remain at "danger" by gravity.

The position of the apparatus when the block is empty, may be summarised as follows:—Both relays energised, the local signal circuit closed, and the electro-magnetic valve operating the pneumatic signal motor consequently open, admitting compressed air to the motor, which holds the signal arm "off." As soon as a train enters the block, the relays are short-circuited by the car axles and thereby de-energised, permitting their armatures to drop, and thus breaking the circuit through the polarised armature coils. The polarised armatures then swing back from their position in contact with one of the track-coil pole-pieces, and in doing so break the signal circuit at two points in series. The electro-magnet operating the admission and exhaust valves of the pneumatic signal motor is de-energised, and the exhaust is opened, permitting the signal to return to "danger" by gravity.

Experience has shown that the greatest obstacle to the success of automatic signalling, on electric railways in particular, is the liability of the relays being operated by extraneous currents; but in this system, while it is possible to energise either one or both relays while the train is in the block, these latter are so interconnected that it is not possible for them both to be energised in the normal direction at the same time by such currents.

The signal apparatus was manufactured at the London works of the Westinghouse Brake Co., and supplied direct to the Underground Electric Railways Co. of London, Ltd., who installed the apparatus themselves.

The power for the operation of the signal and interlocking systems is supplied from the various sub-stations on the line, where signal motor-generator, sets supplying energy at 70 volts pressure to the positive signal conductor and motor-driven Christensen air-compressor equipments are installed. The latter deliver air at 80 lb. pressure to a pipe line extending the entire length of the railway, tappings being taken off where required.

The above plant will be illustrated in connection with the sub-station equipment.

In order to bring all sections of the railway into line with the improved conditions expected under electrical operation, extensive improvements have been carried out in connection with the passenger stations, in which for the most part concrete and ironwork have substituted the old wooden platforms and stairs; the platforms also have been lengthened where necessary.

The tunnels and stations generally, presumably after having received a "spring cleaning," will be lighted by incandescent lamps supplied from three-phase 220-volt lighting mains, the latter being energised from lighting transformers in the sub-stations, fed directly from the H.T. busbars, and thus independent of the traction circuits.

Arc lamps will be installed in the platforms and booking halls, fed in series from the traction circuits.

An independent telephone system is being installed on the District Railway, the scheme including connections to the various passenger and sub-stations, signal cabins, offices and the power station, with a main exchange containing a 300-line board, and distributing frame at the Earl's Court station.

Additional features of the new *régime* will be an electrically-controlled time system with clocks regulated from a master clock situated at the main power station, the clocks being arranged in groups of 20 on circuits energised from the signal motor-generators; also a magazine train describer which also is being installed in connection with the signal system. The latter provides for the automatic display in their correct sequence of a series of illuminated train descriptions on the station platforms.

Three such signs of consecutive arriving trains will be indicated on the instrument, and the departing train cancels its own description.

It will be gathered from the foregoing that the work involved in connection with the railway proper and its accompanying rolling stock has presented no mean task to the engineers engaged upon it. In connection with the permanent way, cable and station work in particular, the majority of the work has, of necessity, been carried out during the brief early morning hours, when the normal traffic was suspended.

In subsequent issues we shall describe and illustrate the Lot's Road power station and typical sub-stations utilised in connection with the power supply to the railway.

(To be continued.)

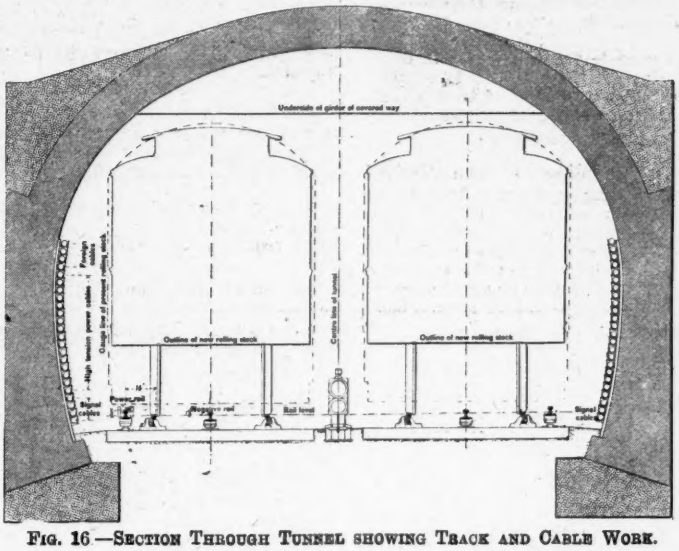


FIG. 16.—SECTION THROUGH TUNNEL SHOWING TRACK AND CABLE WORK.

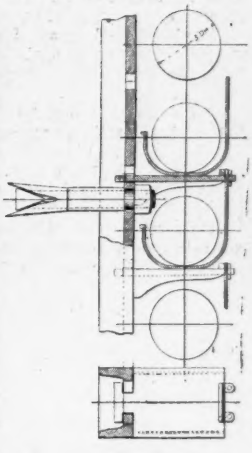
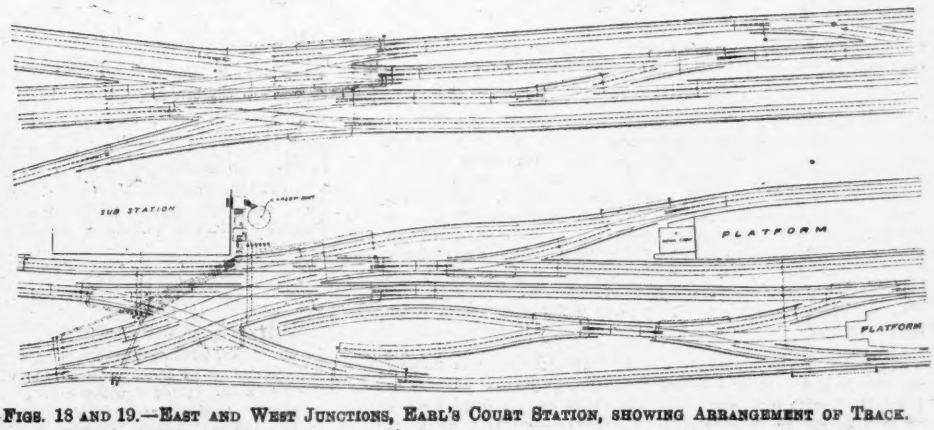


FIG. 17.—DETAIL OF CABLE RACK.



FIGS. 18 AND 19.—EAST AND WEST JUNCTIONS, EARL'S COURT STATION, SHOWING ARRANGEMENT OF TRACK.

TELEGRAPH AND TELEPHONE NOTES.

(*Concluded from page* 895.)

The Indo-European Telegraph Co.—Among the questions which appeared in the Parliamentary papers of Friday, was one by Sir Edward Sassoon, asking the Postmaster-General whether, having regard to the recommendation made in the first report of Lord Balfour's Inter-Departmental Committee on cable communications concerning the Joint-Purse Agreement relating to the transmission of telegrams to and from India, any arrangement had been concluded between His Majesty's Government and the Indo-European Telegraph Co. in connection with the recent renewal of the leasing of land wires in this country and submarine cable wires between Lowestoft and the German coast; whether the terms of such agreement, if any, would be furnished to this House; and what effect such arrangement would have in the direction of terminating or modifying the period of duration of the Joint-Purse Agreement.

Lord Stanley, in reply, said that the negotiations recommended by Lord Balfour's Committee proved to be complicated and difficult, and it was not found practicable to effect the termination of the Joint-Purse Agreement in the manner proposed; but, in connection with the renewal of the lease of wires to the Indo-European Co., steps were taken to provide, as far as possible, that obstacles should not be placed in the way of reasonable reductions of tariff in the future. That was the main ground on which Lord Balfour's Committee desired to terminate the Joint-Purse Agreement.

Submarine Signalling.—According to the *Daily Telegraph*, Atlantic liners are now being equipped with special apparatus for receiving sound signals transmitted through the water from submarine bells. Microphones fixed in tanks on the port and starboard sides of the ship receive the signals and transmit them to telephones on the bridge. The light-ships on the American coast are being fitted with bells, which sound at regular intervals according to a numerical code, whereby the position of each bell is indicated to approaching vessels many miles away.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	..
Trinidad-Demerara (No. 2)	May 11, 1905	May 26
St. Lucia-Martinique	May 7, 1902	..
Dominica-Martinique	May 7, 1902	..
Cayenne-Pinheiro	Aug. 18, 1902	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	..
Closed { Port Arthur-Chifu	Mar. 9, 1904	..
Jamaica-Colon	Jan. 5, 1905	..
Bathurst-Bissao	April 22, 1905	..
Cape Haite-Mole St. Nicholas	April 28, 1905	May 25
San Domingo-Curacao	May 5, 1905	..
Dakar-Conakry	May 11, 1905	..
Paramaribo-Cayenne	May 25, 1905	..
Landlines.		
Puerto-Barrios	July 28, 1902	..
Kertch-Soutchoum	Sept. 27, 1904	..

The Telephone Agreement.—A correspondent writes:—"Leeds has offered little objection, so far, to the terms of the agreement between the Postmaster-General and the National Telephone Co. In Hull, however, where there is a municipal telephone service, it is argued that the new agreement will take away the right of competition, and raise a bigger monopoly than ever. It is stated that Hull is saving about £10,000 a year through having a competitive service, and that Leeds is paying about twice as much as the shipping centre. Mr. Herbert Brown, Chairman of the Parliamentary Committee of the Leeds Corporation, and the town clerk (Mr. Fox) attended a conference of municipalities in London last week, at which the new agreement was discussed."

Wireless Telegraphy.—The Cunard liner *Campania* recently reported that she had been in continuous wireless communication with land throughout her entire voyage from Liverpool to New York. In mid-ocean she had simultaneous communication with America and Europe.

Reuter states that the Postmaster-General, the Minister for Defence and Vice-Admiral Sir Arthur Fanshawe, Commander-in-Chief of the Australian station, are considering a far-reaching scheme for installing a wireless telegraph system connecting Australia, New Zealand, and the outlying islands.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—June 23rd. Tenders for an installation of electric lighting in the Posts and Marine Department in the Rue Ducale, Brussels. Particulars for 1 fr. from, and tenders are to be sent to, La Direction Generale des Ponts et Chaussées, 38 Rue de Louvain, Brussels.

Bracebridge Asylum.—June 7th. Fire alarms, telephones, bells, and tell-tale clocks, for this Asylum. See "Official Notices" May 19th.

Bradford.—June 5th. The Corporation invites tenders for an installation of electric lighting at the School of Art, Great Horton Road. City Architect, Whitaker Buildings, Brewery Street.

Brecon and Radnor Asylum.—June 7th. Wiring and motors for the new farm buildings, also fire alarm installation at the Asylum. See "Official Notices" May 19th.

Darlington.—June 19th. Switchboard extension and booster for the Corporation. See "Official Notices" to-day.

Eastbourne.—June 9th. Concentric cable for the Corporation. See "Official Notices" May 26th.

Edinburgh.—June 5th. Cables for Electricity Supply Department for one year. See "Official Notices" May 26th.

Edinburgh.—June 6th. Steam and exhaust pipe-work for the McDonald Road electricity station. See "Official Notices" May 19th.

Gravesend.—June 14th. The Education Committee invites tenders for the electric lighting of Church Street Council Schools. Specification on application to Mr. C. F. McInnes, Electricity Works, Gravesend.

Grays Thurrock.—June 17th. Storage battery, feed pump, switchboard and economiser extensions, for the U.D.C. See "Official Notices" to-day.

Manchester.—June 9th. The Electricity Committee invites tenders for the supply of the following stores, &c., for one year. Particulars and forms of tender from Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall, Manchester, not after to-day.

Manchester.—June 14th. L.T. cables; amp.-hour and watt-hour meters; box compound. See "Official Notices" to-day.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" May 12th.

Ossett.—June 14th. High-speed engines, dynamos, booster and balancers, battery, switchboard, crane and cables. See "Official Notices" May 26th.

Partick.—June 6th. Water-tube boiler, switchboard extensions, coal conveyor, bunkers, feeder cable, &c. See "Official Notices" May 19th.

Spain.—June 5th. The Spanish Post and Telegraph authorities in Madrid are inviting tenders until June 5th for the supply of 50 tons of galvanised iron telegraph wire 4 mm. dia., and 5 tons of bronze wire 3 mm. dia. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas 10, Madrid.

Swansea.—June 5th. Two motor-alternators for the Corporation. See "Official Notices" May 19th.

Switzerland.—June 9th. The municipal authorities of Lugano are inviting tenders for the construction of an underground derivation canal 7,100 metres long from the River Vernasca, and for the establishment of a water-driven generating station at Zordola (Tenero). Particulars may be obtained from, and tenders are to be sent to, l'Hotel de Ville, Lugano.

Todmorden.—June 8th. Pipework for the electricity works. See "Official Notices" May 26th.

Whitchurch Asylum.—June 14th. Electric lighting installation for the Asylum Visiting Committee of the Cardiff Corporation. See "Official Notices" to-day.

CLOSED.

Brighton.—The Lighting Committee of the T.C. recommended the acceptance of the tender of the British Westinghouse Electric & Manufacturing Co., Ltd., for additional switchgear for connecting up spare cables between the Southwick power house and North Road, at £690, and for isolating switches to all existing feeders and accessories at the Southwick generating station, at £1,450.

Batley.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the laying of the tramlines in Bradford Road, and that of the Western Electric Co., Ltd., for the supply of feeder cables.

Birmingham.—The Tramways Committee has accepted the following tenders in connection with the reconstruction and electrification of the lines of the City of Birmingham Tramways Co. :—

Messrs. Bolckow, Vaughan & Co., Ltd., 1,650 tons of tram rails and fishplates £5 10s per ton.
Hadfield's Steel Foundry Co., Ltd., special rails, &c., £1,703.
Messrs. Dick, Kerr & Co., Ltd., reconstruction of permanent way, £42,262, and 200 tramcars, including spare parts and contingencies, £110,412.

Gloucester.—The Education Committee has accepted the tender of Messrs. Woodward & Co., Ltd., of Gloucester, for installing the electric light at Calton Road Schools, at £265.

Glasgow.—The British Electric Plant Co., Alloa, have received the contract from the Governors of the Glasgow Technical College for an electrical hoist, at a cost of £331 10s.

The offer by Messrs. Marshall, Fleming & Jack, Motherwell, to provide a 2-ton travelling crane for the dynamo room of the Glasgow Technical College, at £88, has been accepted.

The Tramways Committee have accepted the following offers for stores for the current year:—

Chilled paving and brake blocks and car wheels, The National Rail and Tramway Appliances Co., and Miller & Co., Ltd.
Cables, W. T. Glover & Co., Ltd.
Rubber and asbestos goods, George McLellan & Co., and J. T. Goudie & Co.
Axles and steel wheels, Hadfield's Steel Foundry Co., Ltd., and John Baker & Co.
Fifty wheels with cast-iron centres for trials, Messrs. Hurst, Nelson & Co., Ltd.
Steel tires, Glasgow Railway Engineering Co.
Carbon brushes, Le Carbone, Ltd.

Hammersmith.—The Electricity Committee has accepted the tender of Messrs. Bennis & Co., at £747, for a coal elevator for the generating station, also the tender of Mr. John Smith for a 3-ton derrick crane.

London.—The London County Council has had under consideration the undernoted tenders for the supply of 750,000 stoneware ducts for the accommodation of the cables in connection with the reconstruction of the tramways. The accepted tenders were announced in our last issue. The following is a full list:—

	Rate per 1,000 ducts.	Amount of tender (for 750,000 ducts, including full contingencies provision).	Delivery per week.
G. Skey & Co., Ltd., London	£11 19 6	£9,421 5 0	5,000
Stanley Bros., Ltd., Nuneaton	13 0 0	10,250 0 0	10,000
The Stourbridge Glazed Brick and Fireclay Co., Ltd., Dudley	14 10 0	2,791 13 4 (for 250,000 ducts only)	4,000
John Knowles & Co., London	14 11 8	11,437 10 0	5,000
H. R. Mansfield, Burton-on-Trent	14 11 8	11,437 10 0	5,000
Hosea Tugby & Co., Ltd., Ashby-de-la Zouch	14 11 8	11,437 10 0	5,000
Thomas Wragge & Son, Ltd., Swadlincote, Derbyshire	14 11 8	11,437 10 0	50,000
Sutton & Co., Ashby-de-la-Zouch	16 10 0	12,875 0 0	5,000
Ingham's Firebrick Co., Dewsbury	16 13 0	12,987 10 0	10,000
James F. Cummings & Co., London	16 18 6	13,193 15 0	75,000
Naylor Bros., Huddersfield	21 0 0	16,250 0 0	7,500
J. J. Lee, Crumpsall, Manchester	24 0 0	18,500 0 0	10,000

The contract is being divided between Messrs. Skey and Stanley Bros., the former to supply 500,000 ducts for £6,287 10s., and the latter to deliver 250,000 ducts for £3,450.

The L.C.C. also received tenders for the supply and maintenance for ten years, of a battery of accumulators for the Greenwich power station, and for three 10-ton overhead travelling hand-cranes for sub-stations at Streatham, Battersea and Wandsworth. The tenders are as follows:—

Battery for Greenwich Station.

	Price.	Ten years' maintenance.
Tudor Accumulator Co. (recommended)	£1,875 12	£1,120 0
British Accumulator Co.	1,947 10	1,100 0
Electrical Power Storage Co.	2,105 18	900 0
D.P. Battery Co.	2,173 0	1,300 0
Chloride Electrical Storage Co.	2,177 0	1,170 0
Accumulator Industries, Ltd.	2,371 2	1,015 0
A.B.P. Accumulator Co.	2,755 11	2,000 0
Hart Accumulator Co.	3,447 6	2,858 10

Overhead Travelling Cranes.

Herbert, Morris & Bastert, Ltd.	£477*
Jessop & Appleby Bros. (Leicester and London), Ltd.	630*
James Gibb & Co., Ltd.	664
Carrick & Ritchie, Edinburgh (recommended)	678
James Carrick & Sons, Ltd.	680
" " (alternative)	761
J. Smith (Keighley), Ltd.	699
Holt & Willett, Cradley Heath	725
Rodgers & Kaye, Bradford	740
John Hitchen & Son, Ltd.	760
" " (alternative)	775
C. and A. Musker (1901), Ltd.	810
Tangyes, Ltd., Birmingham	871
Ransomes & Rapier, Ltd.	909
James Spencer & Co.	915
Pickerings, Ltd.	927
John M. Henderson & Co.	980
Joseph Booth & Bros., Ltd.	990
Thomas Larmuth & Co.	1,025
Leeds Engineering and Hydraulic Co.	1,085
Thomas Smith & Sons	1,128
Flavell & Churchill	1,150
Steel Rope Pulley Block Co., Ltd.	1,192
Rawlinsons, Ltd.	1,235
Parsons, Brierley Hill, Ltd.	1,275
Cowans, Sheldon & Co., Ltd.	1,290
Dougill's Engineering, Ltd.	1,770
Butters Bros. & Co.	2,385

*Not to specification.

London.—Messrs. A. W. Penrose & Co. have obtained the entire contract from Messrs. A. W. Gamage & Co., Ltd., for the five electric lifts required in their new and old premises.

Portsmouth.—The E.L. Committee has accepted the tender of Messrs. Arrol & Co. for a steel shaft, 200 ft. high, at the E.L. Works, at £1,511.

Rochdale.—The T.C. has accepted the tender of Siemens Electric Appliances, Ltd., for the installation of fire alarm boxes.

Spain.—No more favourable tenders than those of the Madrid Eastern Tramways Co. and the Compania Eléctrica Madrilena de Traccion for the electric tramway concessions in Madrid having been received, the concessions have been granted to these companies.

Walthamstow.—The U.D.C. has accepted the following tenders in connection with the tramways undertaking:—

Machinery for Car Depot.

Hobdell, Way & Co., Ltd.	£167
Pfeil & Co.	47
Herbert, Morris & Bastert, Ltd.	156
Buck & Hickman, Ltd.	1,620
Geo. Hatch, Ltd.	304

Tools for Repairing Shops.—Mr. R. F. Coulston.
Sand-Drying Apparatus.—Mr. E. Robinson, £110.
Engine Oil, Annual Supply.—Messrs. Bentley & Co.

Woolwich.—The Guardians have accepted the tender of Messrs. Clements, Booker & Co., of Westminster, at £747 15s., for the electric lighting at the Union Infirmary, Nurses Home, &c.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 10.30 a.m. Institution of Mining Engineers. Meeting at Burlington House.

Monday, June 5th.—At 7.30 p.m. Society of Engineers. R.U. Service Institution. "The Improvement of London Traffic," by Mr. Charles S. Meik and Mr. W. Beer.

Thursday, June 8th.—At 5 p.m. Royal Institution. Prof. J. A. Fleming on "Electro-magnetic Waves." (Tyndall Lectures.) No. III.

Friday, June 9th.—At 9 p.m. Royal Institution. Sir Wm. H. White on "Submarine Navigation."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders have been issued for next week:—

Monday, June 5th.—"A" Company. Technical Instruction, 7 p.m. Tournament Party Required at Agricultural Hall for Final Display.
Tuesday, June 6th.—"B" Company. Technical Instruction, 8 p.m. Tournament Party Required at Agricultural Hall for Final Display.
Wednesday, June 7th.—No Adjutant's Drill. Tournament Party Required at Agricultural Hall for Final Display.
Thursday, June 8th.—Recruits and Non-efficients for Weymouth Camp Parade at Waterloo Station, 12 noon. "C" Company. Technical Instruction, 8 p.m. Tournament Party Required at Agricultural Hall for Final Display and Massed Bands.
Friday, June 9th.—"D" Company. Technical Instruction, at 7 p.m.
Saturday, June 10th.—Efficients for Weymouth Camp Parade at Waterloo Station, 12 noon.

Wilfrid C. Dumble, Captain.
For O.C.E.E.R.E. (V.)

LIMITS OF STANDARDISATION ON TRACTION SYSTEMS.

[COMMUNICATED.]

The advantages of standardising the apparatus of an electrically-equipped tramway or railway are too obvious to require demonstration. We may, however, point out the limits which govern this process. The systems which are at present in use are:—The direct-current 550-volt system for short routes; the same system provided with rotary conversion for longer tracks; the three-phase induction motor system; the single-phase commutator motor, now being commercially developed on the Continent and in America, and the high pressure three-wire direct-current system as adopted on the City and South London Railway. Each system appears to have its own field of usefulness, and it would be absurd to recommend the employment of any one type for all lines, to the exclusion of others. For example, the characteristic requirements for tramway service in towns are high schedule speed and frequent stops, calling for greater acceleration at good efficiency, and ability of the motor to sustain successive overloads without undue rise

of temperature or commutating difficulties. Absence of complication in the circuit arrangements, and of high pressures, are also indispensable where the density of street population is great. On the other hand, long-distance non-stop services require the efficient transmission of sufficient power to operate heavy cars at high speeds, and very possibly the overcoming of much more severe and continuous gradients than are found in an ordinary town area. With comparatively few stops the heating losses in acceleration are a minimum, and the type of motor giving the maximum efficiency during free running is to be employed. The direct-current motor with series-parallel or regenerative control appears to have proved itself the best for urban traffic, but on its application to longer distances, the cost of sub-station equipment opens up a field of competition for the alternating-current single-phase motor, though hampered in weight and expense by its step-down transformer. The latter type of motor owing to its drooping characteristic on overloads, develops internal heat losses much in excess of those of a direct-current motor of equal capacity during the process of acceleration, and increased weight and bulk of rolling stock are, therefore, entailed for short-run equipments. For normal loads, however, the alternating-current motor gives excellent efficiency, and this tends to give good running economy on long-distance lines with a reduction in the first cost over direct-current equipment. The three-phase induction motor does not yet appear to have found its sphere of usefulness in tramway work, but with the advent of the application of electricity to railway systems, its value would appear to lie in its application to freight haulage over constant gradients, as high terminal pressures can be applied and high constant-load efficiencies obtained. The three-wire direct-current system offers precisely the same relief to direct-current transmission, as it has already done in lighting by economically extending the area of supply. Hence it appears that no one of the systems indicated above is sufficiently flexible to meet every condition of service and gradient existing in an extended tramway system, and it is futile to argue over the supersession of any one type of motor, such as the direct-current apparatus, by another, such as the alternate-current type. Possibly when the drawbacks of the low-voltage commutator, moderate efficiency, pulsating torque and rather poor performance at low speeds pertaining to the alternating-current motor are more completely overcome, it will prove a very formidable rival to the direct-current motor, but the best efficiency of a large system will probably be obtained by sectionalising it according to physical and economic characteristics, and applying to each division the type of motor more particularly adapted for the conditions of operation in that division.

NOTES.

Erratum.—Optical Convention: In our reference to the exhibit by the Cambridge Scientific Instrument Co. of a galvanometer designed by Prof. W. Einthoven, the word *spring* should read *string*.

Institution Notes.—INSTITUTION OF ELECTRICAL ENGINEERS.—The annual general meeting of the Institution was held on Friday last at Westminster. The report of the Council for the session 1904-5 showed that the total membership had increased from 5,410 to 5,677. The Council has awarded "Salomons" Scholarships of value £50 each to Mr. A. E. Clayton, of King's College; Mr. E. A. F. Goodfellow, of the Central Technical College; and Mr. F. C. Prentice, of University College. "David Hughes" Scholarships of £50 each have been awarded to Messrs. E. A. Biedermann and J. B. Sparks, both of Finsbury Technical College. The Institution premium (£25) has been awarded to Mr. E. H. Rayner for his paper "On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics," and "On the Temperature Distribution in the Interior of Field Coils." The Paris Electrical Exhibition Premium, value £10, has been awarded to Prof. H S. Hele-Shaw, F.R.S., Dr. A. Hay and P. H. Powell, for their paper, "Hydrodynamical and Electro-magnetic Investigations regarding the Magnetic Flux Distribution in Toothed Core Armatures"; the Fahie Premium, value £10, to Mr. D. Murray, for his paper "Type Setting by Telegraph." Three Extra Premiums, value £10 each, as follows:—One to Mr. R. Goldschmidt, for his paper, "Temperature Curves and the Rating of Electrical Machinery"; one to Mr. Miles Walker (Manchester Local Section), for his paper, "Compensated Alternate Current Generators"; and one to Messrs. D. K. Morris and J. K. Catterson-Smith (Birmingham Local Section), for their paper on "Some Uses of the Oscillograph." One extra premium, value £5, is awarded to Messrs. J. B. Henderson and J. S. Nicholson (Glasgow Local Section) for their paper, "Armature Reaction in Armatures; an original communication premium, value £10, to Mr. A. B. Field for his communication on "The Dissymmetry of a Three-Phase System"; and an original communication premium, value £5, to Mr. T. Baker for his communication, "The Magnetic Properties of Some Alloys of Iron and Silicon."

The Students' Premiums are as follows:—

The First Students' Premium, value £8, to Messrs. E. A. Biedermann and J. B. Sparks, for their paper on "E.M.F. Wave Forms." The Second Students' Preminum, value £5, to Mr. J. W. Anson, for his paper, "The Present Electrical Equipment of the London County Council Tramways." The Third Students' Premium, value £5, to Mr. A. C. Anderson, for his paper on "The Applications of Electricity in Mines." An Extra Premium, value £4, to Mr. A. E. Jepson, for his paper on "Electric Heating." An Extra Premium, value £3, to Mr. R. F. Chaffer, for his paper on "The Equipment of a Modern Generating Station, with Special Reference to the Chelsea Station of the Underground Railways."

Among the numerous matters mentioned in the report is the statement that in future no candidate will be elected or transferred to the class of Associates who may be eligible for election or transfer to the class of Members, Associate Members, or Students. Students or candidates professionally engaged as electrical engineers can therefore no longer join the class of Associates, which is reserved for persons who are so associated with the application of electricity that the Council consider their admission as Associates would conduce to the interests of the Institution.

The report of the Students' Section showed that a large number of papers had been read and discussed, and many works visited. From May 1st to 6th, 1905, a party of the students visited the Leeds district, and saw the following works:—

Brush Electrical Engineering Co., Loughborough.
Leeds Copper Works, Ltd.
Messrs. Greenwood & Batley.
Messrs. J. and H. McLaren.
Yorkshire Electric Power Co.
Messrs. John Fowler and Sons.
Messrs. Graham Morton & Co.
Farnley Iron Co.
Phœnix Dynamo Manufacturing Co.
Bradford Tramways.
Leeds Corporation Electric Lighting and Tramway stations.

RUGBY ENGINEERING SOCIETY.—This Society paid a visit of inspection to the generating station of the London Underground Electric Railways Co., at Lot's Road, Chelsea, on Saturday, 20th ult.; 75 of the members availed themselves of the opportunity granted through the courtesy of Mr. J. R. Chapman, general manager. The whole of the station was thrown open for inspection, and the members of the party were allowed access to all parts of the installation, with the single exception of the switchboard, which was closed, due to the fact that it was in operation.

RONTGEN SOCIETY.—A paper was read by Dr. W. Deane Butcher last evening on "The Röntgen Congress in Berlin."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. — This Society holds its meeting at Scranton, Pa., next week, opening on June 6th, and closing on June 9th. Among the papers that appear in the programme, a copy of which has reached us, are the following:—"Smoke and its Abatement," by Charles A. Benjamin; "Can a Steam Turbine be started in an emergency quicker than a Reciprocating Engine of the same power?" by A. S. Mann; "Performance of a Superheater," and "Note on Efficiency of Steam-generating Apparatus," by A. Bement.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—At the meeting last week the Board of Trade regulations for certified marine engineers were discussed. Prof. Jamieson submitted a scheme for the training of a marine engineer, which included, *inter alia*, a course of theoretical instruction at evening classes in electricity and electrical engineering.

Electrical Engineers (R.E.) Vols.—On Saturday last an "At Home" was held by "D" Company at Headquarters, when an exhibition of Corps work in running their oil engine sets for lighting, &c., took place. An entertainment followed, and a very enjoyable time was spent by members and their numerous friends.

Widnes—Runcorn Transporter Bridge.—On Monday Sir John Brunner, M.P., opened this transporter bridge across the Mersey. He unlocked the bridge, and a party of the guests were subsequently taken across the river in the car.

Electric Shock Fatality.—A bricklayer's labourer named Fenwick, employed by the North-Eastern Railway, was killed by touching a charged wire at the Gateshead-on-Tyne Railway shops on 26th ult. The inquest was held on 29th ult., and from the evidence it appeared that Fenwick was told to sweep the walls of the boiler house. The deceased took a ladder, and had just mounted it, when a shout was heard, and he was seen to have one of the electric wires grasped in his hands. He was standing on an electric crane, and the wire of which he had hold was one which conveyed current to the crane. The engineer, Matthew Waller, declared he had shut off the current before he left in the afternoon. It was thought that possibly the man had seized the wire to prevent himself falling.—Dr. Robinson said death was due to an electric shock, and a verdict of "Accidental Death" was returned.

London Southern Tramways Bill Rejected.—On Wednesday, without finishing the promoters' case, the Committee rejected this Bill.

King's College Annual Dinner.—The forty-fifth annual dinner of King's College, London, is to be held at the Hotel Cecil on Monday, June 26th, with Colonel Richard H. Jelf, C.M.G., in the chair.

The Decomposition of Calcium Cyanamide.—Before the nitrogen contained in calcium cyanamide can be absorbed by plants, it is converted into ammonia by the action of bacteria. In a recent investigation Löhnis has ascertained that the conversion is similar to that which causes urea to change into ammonia, but slower. When the conditions are favourable, however, the calcium cyanamide decomposes at fair speed and completely, the by-product being calcium carbonate. Out of nine different kinds of bacteria studied, eight are capable of producing more or less ammonia from the cyanamide, and many of these are the common varieties which exist in all soils. The four most powerful bacteria in this respect, and the proportion of the total soluble cyanamide nitrogen which they are capable of converting into ammonia during three weeks' action are:—*B. Kirchneri*, 38·8 per cent.; *B. lipsiense*, 33·5 per cent.; *Bacillus megatherium*, 21·7 per cent.; and *Bacterium vulgare*, 20·2 per cent. The *Bacillus Ellenbachensis* was found to be inert in the conditions of the experiment; but it is manifest that when the chemical and physical nature of the ground is suitable, the nitrogen of the calcium cyanamide will always be converted into ammonia with sufficient rapidity.

The Electrical Production of Steel.—It is reported from Neuhausen that the Héroult steel patents have been acquired by a company specially formed to exploit them, the Aluminium Industrie Aktien Gesellschaft being closely connected with the new enterprise.

Foreigners in German Technical Schools.—It has recently been decided to limit the number of foreign students in the technical high school at Brunswick to 12 per cent. of the total number of scholars in attendance during the preceding half-year, and also not to assign places in the laboratories and drawing offices to the new foreign students until 14 days after the lectures have begun. Next autumn, too, it is intended to increase the fees payable by foreigners, which now stand at 30 marks per half-year. England is evidently not the only country where attention is being devoted to alien immigration and its consequences.

Mechanical Vehicles in London.—Replying to Capt. Norton as to the number of licensed drivers in the country, Mr. Akers-Douglas, in the House of Commons questions, said he could only give the figures for the Metropolitan district. They were as follows:—"There are licensed 10,986 hackney carriages, three of which are driven mechanically; 3,547 omnibuses, 75 of which are driven mechanically; and 1,798 tramcars, of which 967 are driven mechanically. There are 12,763 licensed hackney carriage drivers, 9 of whom hold mechanical licences; and 8,558 stage carriage (*i.e.* tram and omnibus) drivers, of whom 2,006 hold mechanical licences."

American Plant for Japan.—It is reported from New York that contracts have been placed there for electrical equipment, machines, tools and installation for the Japanese Government shipyards and arsenals. The value is £1,000,000, and the material is ordered for shipment with all dispatch.

Electricity in Irrigation.—The method adopted for utilising water power for the generation of electricity for irrigation pumping purposes, and the results obtained, form the subject of a paper recently read by Mr. F. E. Trask, before the American Society of Civil Engineers; the district under consideration being that of Ontario, San Bernardino county in the Orange Belt of California, and the water for the power supply obtained from the San Antonio Canon in the Sierra Madre range. From this Canon the only water supply for irrigation purposes was obtained originally by gravity. This was increased successively by tunnel developments, then by steam pumping from artesian sources, and saturated gravel beds, and finally by electrical pumping, in place of steam pumping, from the same sources.

The water supply of the San Antonio Canon, with two tunnels, was sufficient for the ordinary demands of the original colony, but insufficient for years of drought, and therefore, to increase the scope of the undertaking, large tracts of water-bearing lands were purchased, and 15 wells sunk, which are now operated by induction motors belted to centrifugal pumps.

The current is generated by three direct-connected sets, each composed of a 5-ft. Doble wheel, coupled to a 250 KW. General Electric three-phase revolving field 16-pole generator; each set is controlled by a Lombard governor, and the current is transmitted at 11,500 volts to the sub-stations, the average combined efficiency of the generators and wheels being 77·7 per cent. at the switchboard, and the efficiency of the Doble wheels being 83·6 per cent.

The well equipment consists of an induction motor belted to a centrifugal pump, a combination found to require very little attention.

The pipe system consists principally of cement concrete pipes 8 in. to 40 in. in diameter for the distribution for domestic and irrigation purposes; and the pipe line delivering water to the Doble wheels, which have a working head of 700 ft., consists of riveted steel for the upper part, the remainder being composed of 20 in. lap-welded tubing. The pressure lines were designed for a factor of safety of five, and after two years' service are in perfect condition.

The history of the water, as it may be termed, in this irrigation plant, is well expressed by the author of the paper, when he says: "The small surface stream of the mountains first develops electrical energy to pump water from the gravel beds, and to light the colony, and drive street cars; secondly, it irrigates the orchards at the foothills and above the gravel beds of the pumped water supply; and third, the water not consumed by evaporation and plant life sinks to the gravel beds under these orchards, to be pumped up again for use in irrigating orchards at a lower level."

Production of Nitric Acid from the Atmosphere.—According to a French patent granted to the Westdeutsche Thomasphosphatwerke, nitrous acid is present in all nitric acid made by existing electrical methods, is troublesome to oxidise, and is very harmful in every application of a nitrate except when required as a fertiliser, because of the hygroscopicity of its salts. A good yield of nitric acid containing little or none of the lower compound can, however, be prepared electrically by passing the discharge through a mixture of nitrogen and oxygen, provided the secondary current is obtained by the suitable transformation of a primary current in the generation of which less than 200 watts of power have been employed. The proportion of nitrous acid in the product, indeed, decreases with the strength of the current used. At a strength of 200 watts and upwards, the yield is a mixture of equal parts of both acids; at 180 watts the nitrous acid falls to 45 or 46 per cent.; at 120 watts to 18 or 20 per cent.; and at lower strengths to even 0 per cent. A further advantage of the improved process is said to arise from the circumstance that the electrodes do not melt.

Appointments Vacant.—Demonstrator in mechanical engineering for the Armstrong College, Newcastle-upon-Tyne (£150); junior assistants for the Newcastle-upon-Tyne Electric Supply Co.; assistant electrical engineer for Bray U.D.C. (£60). See "Official Notices" to-day.

Motor-'Buses.—On Monday the Municipal Tramways Conference decided to oppose the North-Eastern Railway Co.'s proposal for running railway motor-'buses. According to the *Standard*, it is proposed at the report stage of the Bill in the House of Commons to limit the service of motor-'buses in districts provided with tramways to the carriage of railway passengers, passengers' luggage, and mails to or from the station or an hotel of the company unless the written consent of the local authority is obtained to a more extensive service.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Gas and Electricity Committee of Rochdale T.C. has recommended that the salary of Mr. ATCHISON, electrical engineer, should be increased by £50 a year.

The Barking U.D.C. has appointed Mr. W. HOLMES as assistant engineer at the E.L. Works at a salary of £125 per annum.

At the meeting of the East London T.C. the resignation of Mr. CUTHBERT MOORE, the town electrical engineer, already mentioned in this column, was accepted with extreme regret, and it was decided that an expression of the Council's appreciation of the valuable and efficient service rendered by Mr. Moore be recorded on the minutes.

Last week Mr. W. H. DUNCAN, testing superintendent at the Harrogate Corporation Electrical Department, was presented with a silver tea service by the staff and employés, on the occasion of his marriage. The presentation was made by Mr. Wilkinson, borough electrical engineer.

Tramways Officials.—Mr. MOONIE, Corporation tramways manager at Aberdeen, has resigned on account of ill-health, and has been granted a retiring allowance of £110 per annum. A proposal to appoint Mr. J. A. Bell, the electrical engineer, as tramways manager also, without any addition to his present salary, did not pass the Tramways Committee. Mr. J. D. CAIRD, the present acting superintendent, was appointed general manager, at £200 per annum.

It is stated that Mr. ALEX. MILLER, A.M.I.C.E., has been appointed resident engineer for the new electric conduit lines which the London County Council is about to construct.

General.—The Sir John Pender gold medal and bursary in the department of electrical engineering in the Glasgow Technical College has been won by Mr. GEORGE HERBERT STEVENSON.

Mr. SIDNEY C. SHEPPARD has resigned his position on the staff of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, and is leaving to take up an important position under the Bolivian Government in about 2½ months' time. Mr. Sheppard (c/o Mr. E. E. Abrahamson, 14, Wormwood Street, E.C.) will be glad to receive catalogues and notices of specialities with reference to electrical plant of all kinds, and especially to railway and tramway traction work.

At a meeting of the directors of the Telegraph Construction and Maintenance Co., held on May 30th, the vacant chairmanship was filled by the appointment of Mr. WILLIAM SHUTER, whom everyone has known for so long as managing director of the company. Mr. F. R. LUCAS, who has been for many years chief engineer to the company, was elected a director to fill the vacancy on the board caused by the death of Sir Robert Herbert. Mr. Shuter and Mr. Lucas have been associated with the company from its foundation, and the management will now be shared by them, they having been appointed joint managing directors.

NEW COMPANIES REGISTERED.

Incorporated Association of Electric Power Companies (84,702).—This company was registered on May 24th, with an unlimited number of members, each liable for £50 in the event of winding up, to encourage, expedite and facilitate the development of the industry of supplying electrical energy for power, light and other purposes, to protect the interests and further the objects of companies or persons possessed of electrical power supply Acts, &c. The word "limited" is omitted from the title by licence of the Board of Trade. The first subscribers are:—T. O. Callender, Hamilton House, Victoria Embankment, E.C., director of North-Western Electricity and Power Gas Co.; J. Devonshire, 101, Finsbury Pavement, E.C., director of North Metropolitan Electric Power Supply Co.; H. A. Earle, Knightsbridge Mansions, S.W., director of Yorkshire Electric Power Co.; F. E. Gripper, Broad Sanctuary Chambers, Westminster, director of Lancashire Electric Power Co.; W. L. Madgen, Victoria Works, Belvedere Road, S.E., director of County of Durham Electric Power Supply Co.; C. H. Merz, 28, Victoria Street, S.W., consulting engineer to Newcastle-upon-Tyne Electric Supply Co., Ltd.; and D. A. Storr, 8, Bothwell Street, Glasgow, general manager to Clyde Valley Electrical Power Co. The management is vested in a council. Registered office, 25, Ironmonger Lane, E.C.

"Otto" Electrical Manufacturing Co. (1905), Ltd. (84,736).—This company was registered on May 26th, with a capital of £75,000 in £1 shares, to acquire the business of the "Otto" Electrical Manufacturing Co., Ltd., to adopt an agreement with A. C. M. Jenkins & Co., and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power, or other purposes, manufacturers of and dealers in electrical apparatus, cables, wires, lines, lamps and accessories, &c. The first subscribers are:—J. Deakin, The Hall, Wormhill, Buxton, Derby, late manager of Manchester Brewery Co., 500 shares; W. G. Reddie, 13, Fenchurch Avenue, E.C., 500 shares; H. D. Boret, 144, Leadenhall Street, E.C., shipbroker, 500 shares; F. G. Exell, 6, Valley Road, Streatham, S.W., clerk, 1 share; H. Howard, 52, Nansen Road, Battersea, clerk, 1 share; F. A. Dawson, 300, Southampton Street, Camberwell, S.E., accountant, 1 share; and R. Stocks, Lombard House, George Yard, E.C., clerk, 1 share. Minimum cash subscription, £20,000. The directors' borrowing powers are limited to £50,000. The number of directors is not to be less than three nor more than seven; the first are H. D. Boret, J. Deakin and W. G. Reddie; qualification, £500; remuneration (except managing director), £100 each per annum and £50 extra for the chairman.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Blackpool, St. Annes and Lytham Tramways Co., Ltd. (59,184).—Issue, on May 20th, of £5,000 debentures, part of series created by resolutions of January 12th and March 13th, 1905, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: W. S. Curties and S. B. Murray, both of 5, Threadneedle Street, E.C. No trustees. Previously issued of same series: £10,000.

Clift Manufacturing Co., Ltd., switchboard manufacturers, &c., London (84,505).—£1,000 debentures, created and dated May 11th, 1905, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. Holder: W. J. F. Kalyis, Maidenhead. No trustees.

Woking Electric Supply Co., Ltd. (46,175).—This company's annual return was filed on May 22rd, when 25,000 preference and 17,212 ordinary shares had been taken up and paid for in full out of a nominal capital of £50,000 in 25,000 preference and 25,000 ordinary shares of £1 each. Mortgages and charges: £24,850. (£150 further debentures were issued on May 6th.)

Issue, on May 6th, of £150 debentures, part of series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £24,850.

Potteries Electric Traction Co., Ltd. (57,968).—Particulars of a series of debentures authorised by resolutions of March 28th, 1900, and May 11th, 1905, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. The subscribed capital, at date of last return, was £489,990. Property charged: The company's undertaking and general assets, present and future. There are no trustees for the debenture-holders, but the debentures are issued to trustees for holders of debenture stock acting under a trust deed, dated July 26th, 1900. Some of the debentures of this series have already been registered.

North Wales Power and Traction Co., Ltd. (78,193).—A trust deed, dated May 4th, 1905, to secure £135,000 debenture stock, has been registered. Property charged: The company's land and buildings, with certain exceptions and all its other property and rights, present and future, except uncalled or unpaid capital. Trustees: London and New York Investment Corporation, Ltd., 18, St. Helens Place, E.C.

Mann, Egerton & Co., Ltd., electrical engineers, Norwich and elsewhere (83,780).—Issue, on May 22nd, of £200 debentures, part of series created April 1st, 1905, to secure £10,000, charged on certain freehold and leasehold properties in Norwich and Ipswich and the company's undertaking and property, present and future, including uncalled capital. Trustees: G. F. Buxton, Dunston Hall, Norfolk; and J. J. D. Paul, Eaton Grove, Norwich. Previously issued of same series: £3,500.

Kidderminster and District Electric Lighting and Traction Co., Ltd. (59,972).—This company's annual return was filed on May 4th, when 3,000 preference and 4,700 ordinary shares had been taken up out of a nominal capital of £100,000 in £10 shares (5,000 preference). £10 per share has been called up, and £77,000 has been received. Mortgages and charges, £27,500.

Willans & Robinson, Ltd. (40,660).—This company's annual return was filed on April 20th, when 66,666 preference and 66,666 ordinary shares had been taken up out of a nominal capital of £750,000 in £5 shares (75,000 preference). £5 per share has been called up on 52,203 preference and 52,204 ordinary, and £522,035 has been received. £144,625 is considered as paid on 14,463 preference and 14,462 ordinary. Mortgages and charges, £216,813.

ELECTRICITY SUPPLY ACCOUNTS.

Bury Municipal Electricity Supply.

THE improvement which we have periodically noted in connection with the electrical department of this town, is this year, 1905, most marked.

The practical completion of the tramway system has added some 600,000 units to the annual output, in addition to favourable increases in the direction of private and public lighting; the total output for the year amounting to some 1,300,000 units, as compared with 700,000 units in 1904.

The working costs show, of course, a great improvement on 1904, and would doubtless have shown even greater improvement had the load factor remained at last year's level of 16 per cent.

The reduced load-factor is due to a temporary decrease in the units used for motive-power purposes, although the motors added during the year were above the average. The low tramway load-factor is due to the system only having been completed in September last, also to the abnormal loads which are dealt with in connection with football traffic; the normal maximum load was 472 KW., but football traffic brought it up to 715 KW.

The chief engineer is Mr. S. J. Watson, M.I.E.E.

The following table is of interest in connection with the Bury supply:—

	Units.	Maximum load.	Load factor.	Load factor (1904).
Lighting	297,202	310 KW.	11·0%	11·1%
Public lamps	62,801	21 KW.	34·2%	28·5%
Motors and heat ...	258,208	112 KW.	26·3%	31·4%
Total light and power	618,211	443 KW.	15·9%	17·3%
Tramways	662,250	715 KW.	10·6%	8·5%
	1,280,461	1,158 KW.	12·6%	15·7%

As a result of the year's working, a balance of some £3,000 remained after meeting all expenses, this comparing with £566 in 1904.

GENERAL STATEMENT.

For year ending March 31st—	1905.	1904.
Total capital expended	£76,408	£72,080
Number of units sold—		
Private supply	555,410	550,617
Public lighting	62,801	54,664
Traction	662,250	67,630
Total number of units sold ...	1,280,461	672,911
Equivalent No. of 8-C.P. lamps connected	44,199	38,095
H.P. of motors connected	581	470
Number of public lamps	34 a. 18 inc.	34 a. 18 inc.
Maximum load in KW.	1,158	487
Revenue Account—		
Gross revenue	£11,357	£8,105
" expenditure	£5,226	£4,610
" profit	£6,131	£3,495
Average inclusive price obtained per unit—		
Private supply	2·96d.	3·08d.
Public lighting	2·24d.	2·63d.
Traction	1·40d.	1·50d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1905.

Gross revenue	£11,357 =	2·15d. per unit.
Works and distribution costs (including public lighting)	£3,357 =	·63d. "
Total working costs*	£5,226 =	·98d. "

* Includes bank interest, £610.

PROFIT STATEMENT.

Interest on loans	£1,710
Sinking fund	1,489
Balance on year's working	2,932
Gross profit	£6,131

CITY NOTES.

West India and Panama Telegraph Co.

THE meeting of this company was held on Wednesday last week at Winchester House, Mr. W. B. Kingsford presiding.

The CHAIRMAN, in proposing the adoption of the report, said the receipts for the half-year were £27,136 as compared with £32,399, showing a decrease of £5,263. The diminution of their traffic receipts, subsidies, &c., accounted for £2,456 of the decrease, but there were two special items amounting to £2,986 for income-tax accumulation and the surplus on the loss of the *Grappler*, which appeared in the corresponding period, and which did not appear this half-year. The expenses were £21,422 as compared with £25,243, a net decrease of £8,821. That reduction arose from their having received £4,050 for the charter of the *Henry Holmes* during the half-year, which consequently reduced the expense under the head of repairs and renewal of cables. In addition, there was a saving of £377 in the cost of maintenance of landlines. In the corresponding period, their landlines in Jamaica were considerably damaged by a great hurricane, of which, happily, there had since been no reoccurrence. In accordance with their usual practice they had charged against reserve for renewal of cables the cost of the 49 knots of new cables, which was used in the repair of the two cables between Jamaica and Porto Rico, which amounted to £3,446. It was a matter of regret that the traffic receipts showed a decrease of £1,862, and that those for the current half-year also showed a considerable decrease at the time the report was issued. Since then, however, they had received the returns for May 15th of the estimated traffic receipts, and those, he was glad to say, showed a

marked improvement. They feared, however, that that improvement might be due entirely, or in a great measure, to special circumstances, which they thought were likely to prove merely of a transient character. The decrease of £1,862 arose from there having been less telegraphic activity at the Isthmus of Panama. That was due, in the first place, to the fact that in the corresponding period certain important political changes were taking place there; and, secondly, to the fact that in the corresponding period the French Co.'s traffic was diverted to their lines owing to an interruption of their route, which lasted for three months. He noticed with regret that their traffic receipts on the British West Indian stations had remained absolutely stationary as compared with those of the December half of 1903. That was somewhat disappointing, because they had reason to believe that there would certainly have been some increase owing to the failure of the Continental beetroot crop, and the higher prices accordingly obtained for West Indian sugar, also to the reported improvement generally in the commercial prospects of the West Indies. Their cable between Jamaica and Colon had been interrupted since January 9th, and thus far they had been unable to undertake its repair, as their repairing ship had been fully engaged in other parts of their system; they hoped, however, soon to be able to take the work in hand. During the early part of last year they were in confidential communication with the Government with reference to extending the cable system in the West Indies, and certain proposals were made by them which, if carried out, would have involved the grant of an Imperial subsidy. Under the new Naval defence scheme for the Empire, the Government had decided to withdraw the white troops from the West Indies, and to reduce the Naval forces in those waters, also to discontinue the maintenance of St. Lucia as a defended coaling station. Under these greatly altered circumstances, the Colonial Office had recently informed them that their proposals could not be entertained. In conclusion, he referred with regret to the resignation of Mr. Andrews, owing to ill-health, and said that that gentleman had been a director of the company for more than 31 years, and for five years had acted as its chairman.

Mr. Henry Holmes seconded the report, and it was carried.

Callender's Cable and Construction Co.

The ninth annual meeting of this company was held on May 25th at Hamilton House, Victoria Embankment, Mr. Henry Drake presiding.

In proposing the adoption of the report (see Electrical Review), the Chairman said that the amount carried to profit and loss was £45,281, as against £46,456 last year. That was an apparent reduction; but, as a matter of fact, the cost of issuing the debenture stock, which amounted to £2,777, had been written off, and that made it about £1,500 more than last year. Additions had been made during the year to the properties of the company at Erith of an amount of £11,589. They had written off for depreciation of plant and machinery £12,166, and the transfer to Leigh, amounting to £909, had been deducted. The goodwill and patents stood in the balance-sheet at *nil*. That was a very satisfactory item, because it meant that they had written off everything in their books. Although it was a very valuable asset, they did not take it into account. The stock at Erith amounted to £115,480, as against £101,039 in the previous year. The expenditure on contracts in course of execution was almost identical with that of the previous year, being £98,251, as against £98,259. Cable drums stood at £21,475, as compared with £20,980. That showed that they were doing more business. Sundry debtors and other accounts amounted to £184,909, as against £160,803, and the amount retained by corporations for due fulfilment of contracts was £94,356, as against £99,482. That was an item which pressed rather hardly upon them, because they received no interest on the money. It was a very serious lock-up of capital, but, on the other hand, the shareholders must not forget that the reserve was employed in the business, and, therefore, they might fairly set the one against the other and look on it as an investment of the reserve. Cash at bank and in hand, and bills receivable, amounted to £19,342, as against £60,854. They had not been able to get the money due from corporations as quickly as they would have liked. The corporations themselves found it very difficult to get money in, so that they could not pay the company as quickly as they otherwise would. Shares and investments in other companies stood at £57,913, as against £37,688. They were obliged sometimes to take shares in other companies in order to secure contracts. The item "Anchor Cable Co., Ltd.," stood in the last account at £72,796, and there had been additional advances made during the year to the extent of £13,440. At the time the business of the Anchor Co. was taken over, they had advances from their bankers, and they had had to advance the money to pay them off. Turning to the profit and loss account, the profit for the year, after deducting all charges on manufacturing accounts and contracts, was £94,163, and after debiting the expenses there was a balance carried down of £57,065, as compared with £52,646 last year, being an increase of about £4,400. Adding the balance brought forward from 1903, they had a sum of £81,646 to deal with. The net balance, after providing for depreciation, the interest on the debenture stock, the dividend on the preference shares, and setting aside £2,777, the cost of the issue of the debenture stock, was £45,281. They proposed to pay a dividend of 10 per cent. on the ordinary shares, which would absorb £17,500, and a bonus of 2s. 6d. per share on May 31st, amounting to £4,375, and to carry forward a balance of £23,406.

Sir Fortescue Flannery, M.P., seconded the motion.

Mr. T. O. Callender, the managing director, made a statement regarding the position of the company. He said that the small amount of manufactured stock which they were in the habit of carrying was a feature of great strength. At the present time they had only £17,000 worth of such stock, so that, if any special kind of cable went out of use, they would not have a large amount of useless stock. The increase in the stock of raw material was mostly due to large supplies of Trinidad bitumen, which they had found it expedient to keep in stock. As the chairman had told them, the goodwill stood at nil, and in that respect he thought they would compare most favourably with other manufacturing companies. With regard to the business done last year, he did not remember any period since the company was started in which it was more difficult to obtain orders, or in which, as a general rule, the orders were obtained at less satisfactory prices. Their work was largely with municipalities, and the financial stringency and the new views which prevailed as to municipal trading had had a considerable influence on the amount of work which was usually carried out by local bodies. Their works at Erith were in a most excellent condition, and he believed they were in a position to face competition better than any firm in the same line of business, not only in this country, but abroad. They had, therefore, no uneasiness about the future. There were indications at present of a distinct advance in engineering matters, and he hoped they might result in good business for the company. With regard to power companies with which they were concerned, he thought they would agree that the views which he had held out in the last two years, had been fully justified. They were getting a considerable trade in the important business of power distribution, and he had reason to think that the future of these large companies would revolutionise much of the trade of their company. The very fact that they had been in it from the beginning gave them a very strong position, and it was a position which they would do their utmost to maintain. The policy of the board in acquiring the business of the Anchor Cable Co. had been fully justified, and although it was not yet in a paying condition, it had been of the greatest possible use to them, and had indirectly contributed to a considerable extent to the results of the past year. They were all looking forward to an improvement in the rubber trade, but whether it would come next year or later he was unable to say, as it depended very largely on the prosperity of the motor industry.

The report was then adopted.

West African Telegraph Co.

The meeting of this company was held on Wednesday at Electra House, Finsbury Pavement.

The Marquis of Tweeddale, in proposing the adoption of the report, said that the gross income for the past year had amounted to £60,900, being a decrease of £1,600. The receipts from traffic showed a decrease of £3,661, but on the other hand, the loss on exchange was less by £1,279, while interest had yielded £750 more. Turning to the other side of the accounts, the total ordinary expenses for the year had amounted to £14,900, being a decrease of £600. That decrease was almost entirely due to the reduced expenditure in respect of repairs to station buildings, maintenance of electrical instruments and apparatus; the other items of expenditure varying in a very slight degree. The expense attending the maintenance of cables was practically the same in 1904 as it was in the previous year. It would, however, be noticed that the expenditure in the year under review included £3,515 in connection with the repairs of certain cables for the French Government, which they were liable to maintain in accordance with an arrangement made with that Government. That arrangement expired in September, 1904, so that no expenditure on account of those cables would appear in the accounts in future. The charge in respect of the maintenance of their own cables amounted to the comparatively small sum of £6,300. The net result of the year's working was a profit of £36,079, which, added to the balance of £2,663 brought forward from last year, made the total amount available for distribution £38,742. After providing for income-tax, the directors had transferred £25,000 to the reserve, and had paid an interim dividend of 2 per cent. It was now proposed to pay a final dividend of 2½ per cent., making 4½ per cent. for the year, as against 4 per cent. in 1903, and to carry forward the balance of £1,600. He referred last year to the large amount carried to the reserve fund, and he might say again that although the figure appeared somewhat large, it could not be deemed excessive when the age of their cables and the prospective termination of the Portuguese guarantee were taken into account. He thought it would be agreed from the figures he had put before them that the company was in a satisfactory, and he might even say a prosperous, condition.

Sir John Denison Pender seconded the motion, which was adopted.

Brisbane Electric Tramways Investment Co.

Sir M. D. MacEcharn, in moving the adoption of the report at the recent meeting of this company held in London, said that the Brisbane Tramways Co., in which they held all the shares, had placed £3,000 to the renewals fund, paid £44,000 in dividends and carried forward £2,908. Their own company had a net balance of £44,239; £18,188 went for debenture interest, £5,000 was placed to reserve, £500 to start an accident insurance fund, and after paying 5 per cent. on the preference shares £2,719 remained to carry forward. The Toowong extension was opened in July last year, and an increased car-mileage of 86,000 was run; the traffic receipts were £543 more, and the expenses were less than for 1903. The

net result was practically the same. Queensland had been passing through a time of serious depression, and systems such as this which were dependent upon the wage-earner for support had to suffer in consequence. They believed that the tide of adversity had turned, and that Brisbane would be the first city to feel the effect of a reviving commerce. The report was adopted.

Amazon Telegraph Co.

At a meeting of the holders of the outstanding debentures, to be held at 42, Old Broad Street, E.C., on Tuesday, June 6th, 1905, extraordinary resolutions will be submitted proposing that the interest upon the outstanding debentures secured by the trust deed dated August 5th, 1897, due and to accrue due up to June 30th, 1905, shall be capitalised, and that the coupons representing such interest shall be given up in exchange, at par, for debentures or scrip certificates exchangeable for debentures bearing interest at 5 per cent. per annum as from June 30th, 1905, and ranking *pari passu* with the outstanding debentures secured by the said trust deed.

In order to provide the necessary debentures or scrip to give effect to the resolution, the company may either re-issue a sufficient number of debentures of the said issue which have been already got in and satisfied, or create and issue a sufficient number of new debentures which may bear denoting numbers corresponding with those borne by debentures which have been already satisfied. In addition to the necessary debentures or scrip issued in pursuance of these resolutions the company may, from time to time, re-issue such a number of debentures of the said issue which have already been got in or satisfied, or may issue such a number of new 5 per cent. debentures as shall, with the amount of debentures issued in pursuance of the last preceding resolution, amount to a sum not exceeding £75,000.

Sunderland District Electric Tramways, Ltd.

The report stated that during the year the work of construction of this company's tramways had been proceeded with, and it was anticipated that the first section of the tramways would commence operating about the date of the meeting. The construction of the line, says an abstract in the *Financier*, has been unavoidably delayed by protracted negotiations in connection with road widenings, but nearly all the difficulties in connection with these have been practically overcome. The power station is in course of erection, and is nearly completed. It is expected that the second section of the tramways, from Houghton-le-Spring to South Hetton, will shortly be constructed, the company having made financial arrangements to meet the outlay upon the construction of this section, and a large amount of the calls in arrear at the date of the balance-sheet having been since collected. The directors report that they have entered into a contract with the Durham Collieries Electric Power Co., Ltd., whereby that company operates under rent and royalty the right to supply electric light and power in the district covered by this company's orders, and at the same time they have further arranged with the Durham Collieries Electric Power Co., Ltd., to supply the Sunderland District Tramways, Ltd., with the power necessary for driving their electric plant for the operation of the tramways.

The annual meeting was held at 13, St. Helen's Place, E.C., on Wednesday. The Chairman, Sir Riley Lord, in moving the adoption of the report, mentioned that it was proposed to commence operating the system on June 8th.

Stock Exchange Notices.—The Committee has appointed Thursday, June 8th, to be a special settling day in Shawinigan Water and Power Co.—Scrip (fully and partly paid) for $2,000,000 5 per cent. consolidated first mortgage bonds, and has ordered the undermentioned securities to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—£115,000 5 per cent. cumulative perpetual preference stock, in lieu partly of the 5 per cent. cumulative perpetual preference shares now quoted.

Shawinigan Water and Power Co.—Scrip (partly paid) for $2,000,000 5 per cent. consolidated first mortgage bonds.

South Metropolitan Electric Light and Power Co., Ltd.—Further issue of £35,368 7 per cent. cumulative preference shares of £1 each fully paid, Nos. 200,001 to 235,368; and £48,292 4½ per cent. first debenture stock.

Electricity Supply Co. for Spain.—A second drawing of 6 per cent. first mortgage and 7 per cent. "B" mortgage debentures has taken place to the amount of £12,000, and the bonds will be paid off on June 30th.

Oriental Telephone and Electric Co.—Sir Auckland Colvin presided at the extraordinary meeting held on Wednesday, and the resolution for creating £200,000 debentures, to be issued as the directors may deem expedient, was carried unanimously. The chairman explained that the capital was needed for underground cabling and other similar work, also for the development of the Telephone Co. of Egypt, the Bengal Telephone Co., and the China and Japan Telephone Co.

Western Telegraph Co.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended March 31st, 1905.

STOCKS AND SHARES.

Wednesday Evening.

Peace prospects have displaced the hopes of cheaper money as the most bullish factor in Stock Exchange markets for the time being. The Japanese victory has relieved a great tension, for in spite of the unanimous belief that Russia would be beaten, the element of uncertainty was freely recognised. Not everyone had the courage to buy Japanese bonds at the end of last week, when prices were considerably lower. But the strain is over for awhile, and prices in nearly every section have been hoisted, even allowing for the inevitable reaction upon the idea that peace will hasten less slowly now that Russia is severely crippled on the seas.

In the departments with which we deal the changes are perhaps less marked than they are in any other. Telegraph and electrical issues have kept so exceedingly steady what time the other markets fell upon the war news, that there is less reason for them to "boom" upon the Japanese victory. There are certainly a few advances to notice, but they lack sensation, and in no case do they approach the dramatic.

Of telegraph descriptions, it is worth noticing that the acute weakness in West India and Panama Preferences has been stayed. The Ordinary shares cast ¼ at 8s. 9d., but these are such very long shots that their value is at best a fancy quantity. The Second Preference continue at their lower level of 6, and the Firsts are 7¼ *ex* dividend, looking fairly attractive at that price to anyone who cares to buy speculative investment shares. There is a better tone in the Anglo-American group, where the bears of the "A" stock have received a sharp check, the price has risen ⅜ to 15⅝, but the other two of the company's stocks are unaltered. A fall of ¼ to 11¼ in Direct United States Cable shares is somewhat contradictory. Cuba Telegraph Preference have slipped on to the up-grade once more, the price gaining 10s. at 16 middle. The Eastern division shows irregularity, Eastern Ordinary being a point to the good, and Eastern Extension 10s. down at 14. No change has occurred in the Trust companies' issues except for *ex* dividend markings.

Better prices constitute the feature in the Traction market Barcelona Trams are up as much as 27s. 6d., better at 13, and from the character of the demand it would appear as though another effort were being made to secure control, perhaps for the local authorities Anglo-Argentine Ordinary improved to 8½, and the Preference to 6⅛. Metropolitan Electric Tramways Preferred are now a trifle over par, but Deferred keep about 6s. 3d. The new Ordinary are now 2s. 6d. premium. Rises of ¼ and ¼ fell to British Electric Traction Ordinary, and Preference at 9½ and 11⅝ respectively Inquiry for British Columbia Electric Deferred has put the price to 106, while the Preferred is 101½. London United Tramway Preference are maintained at 10, and the Debenture was done at 100½ on Tuesday.

Railway stocks, on the whole, have hardened in company with Consols, but the electrical varieties are out of favour. Districts slipped back to 37 upon the County Council's success with its new scheme for tramways along the Embankment and over the bridges. On the other hand, Metropolitan Consolidated hardened to 94, and in the case of dividend-paying stocks, the approach of the half-year's conclusion should stimulate buying. That this is not so in regard to Waterloo and City can be seen by the fall of 1 in the price to 91½. Great Northern and City Preferred at 5½ show signs of uneasiness as the time draws nearer for the termination of the contractors' agreement with respect to the payment of the dividend. We notice that the shares are being recommended for investment by a penny daily paper whose conservatism over finance is the least liberal part of its policy. It may be observed that a fairly large block of shares came to market the other day.

Central Londons are as they were a week ago, and City and South London remains at 41. The 4 per cent. Debenture stocks stand at 111 and 108½ respectively, the margin being mainly due to the different dates upon which the interest payments fall due.

Metropolitan Electric Supply are ¼ better at 9½ upon the proposals to split the shares, but Chelseas are down ½ to 6⅜, and Notting Hills ¼ lower at 14⅜. County of London 4½ per cent. Debenture stock at 114½ has followed the rise secured by the Second Debenture stock last week. A further drop of ½ brings Brush Ordinary to 1½, but there is a still a disposition to buy the Debenture stocks of the Ediswan Co. Manufacturing shares are quiet. Westinghouse Preference have eased off to 2½⅛, and Babcocks to 5½. Telephone descriptions show a rise of 1½ to 111 in National Preferred, and the Deferred is 2 points better at 104. Both stocks have been avidly bid for in the market this (Wednesday) afternoon, but the only explanation available was connected with the sitting of the Commission.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations May 24th.	Closing Quotations May 31st.	Business done week ended May 31st, 1905. Highest	Lowest
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼ — 2⅝	2¼ — 2⅝	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	75 — 80	76 — 81	..	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2³⁰⁄₄₀%	59 — 61	59 — 61	..	..
3,118,210	Do. do. 6 % Pref.	Stock	6 %	6 %	5⁴⁰⁄₄₀%	105 —106	105 —106	105⅝	105
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	15⅜ — 15⅝	15⅝ — 15⅞	15⅞	15⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅜ — 6½	6⅜ — 6¼	6³⁄₃₂	..
15,000,000‡	Commercial Cable	$100	8 %	8 %	8 %	230 —240	..	..	..
1,932,856‡	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97 — 99	97 — 99	98⅜	98⅜
16,000	Cuba Telegraph	10	6¼%	5 %	5 %	8 — 8½	8 — 8½	..	..
6,000	Do. 10 % Pref.	10	10%	10%	10%	15 — 16	15½ — 16½	16	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10%	10%	10%	8½ — 9	8½ — 9	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	101 — 103	101 —103⅝	..	..
60,710‡	Direct United States Cable	20	8¼%	8 %	..	11¼ — 11½	11⅜ — 11½	11⅛	11¼
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	139 —142	140 —143	142	140⅔
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	..	91 — 93	91 — 93	91	..
1,836,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109	107 —109	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½ — 14⅔	13⅔ — 14¼	14¼	14
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105 —107	105 —107	106⅔	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	4 %	4 %	4 %	100 —102	99 —101	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	99 —101	100 —102	..	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5½%	5⅝%	10½ — 10⅔	10½ — 10½xd	10¹¹⁄₁₆	10⅝
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅜ — 15	14⅜ — 14¾xd	14⅝	14⅜
150,000	Great Northern Telegraph, of Copenhagen	10	19½%	15 %	24 %	34 — 35	34 — 35	34⅜	34⅛
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	13 %	50 — 52	50 — 52	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅜ — ⅝	⅜ — ⅝	..	..
1,988,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	109 —110	110¼—111½	110⅝	109
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	101 —103	103 —105	103	102
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½ — 13½	12¾ — 13½	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11¼ — 12½	11¼ — 12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5⅜	..
4,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —102	100 —102	..	..
1,989,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104⅜	104¼
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	6½%	1⅜ — 1⅝xd	1⅜ — 1⅝	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1⅛ — 1½ xd	1⅛ — 1½	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	99 —102	99½	..
11,889‡	Reuter's	8	5 %	5 %	5 %	7⅞ — 8½	7⅞ — 8 xd	..	..
8,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	123 —126	123 —126	..	..
58,000	United River Plate Telephone	5	7 %	8 %	..	6⅜ — 7⅛	6⅜ — 7⅛	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	107 —109	107 —109	..	..
15,609‡	West African Telegraph, Shares	10	9 %	4 %	4½%	8 — 8½	8 — 8½	..	..
80,008	West Coast of America, 1 to 80,000 and 53,001 to 53,009	2½	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..
150,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13⅛ — 14	13⅛ — 14	13⅜	13⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	101 —103	101 —103	..	..
568,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	103½	..
88,891	West India and Panama Telegraph	10	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	7½ — 7⅞	7 — 7⅞	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	5⅞ — 6½	5⅞ — 6½	..	..
60,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —106	104 —106	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	5 — 5½	5 — 5½	5½	..
40,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅜ — 5⅛	4⅜ — 5⅛	5	..
20,000	Do. do. 4% Funding Certs.	5	..	..	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	98 —102	98 —102	..	..
133,301	British Electric Traction	10	8 %	6 %	..	9⅛ — 9⅝	9⅛ — 9⅝	9⅝	9⅛
156,437	Do. do 6 % Cum. Pref.	10	6 %	6 %	..	10⅜ — 11⅜	11⅛ — 11⅜	11⅛	11⅛
1,000,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	121 —123	122 —124	124	..
250,000	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	4½%	97 — 99	97 — 99	98½	94
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5¾ — 6	5¾ — 6	5⅞	5¾
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5¾ — 6	5¾ — 6¼	6	5⅝
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	103 —105	103 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	¼ — ⅜	¼ — ⅜	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1⅜ — 1¾xd	1¼ — 1½	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	79 — 82	79 — 82	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10¾ — 11¼	10 — 11	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..
300,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	107 —109	107½ —109½	108⅝	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	91 — 93	91 — 93	92½	91
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	101½	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	80 — 83	80 — 83	..	..
1,889,000	City and South London Railway	Stock	3½%	3⅜%	2⅜%	40 — 42	42 — 43	40	..
85,000	Crompton & Co., Nos. 1 to 85,000	2	5 %	2½%	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	5 %	5 %	5 %	95 —100	95 —100	99	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	1½ — 1⅝	1½ — 1⅝	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	2 — 2½	2 — 2½	..	..
344,928‡	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	83 — 88	83 — 88	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	87 — 92	88 — 93	93	91½
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	..	⅞ — 1⅛	1 — 1⅛	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	..	2¼ — 2⅜	2¼ — 2⅜	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅜ — 10¼	9 9⅜ — 10¼	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 —101	97 —101	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	11⅜ — 12½	11⅜ — 12½	12½	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10%	..	15½ - 16½	15½ - 16½	..	..
300,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100—103	100 —103	..	..
97,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅜%	1½%	3⅜ — 3½	3⅜ — 3½	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9½ — 9⅝	9½ — 9⅝	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	33 — 35	33 — 35	34½	33½
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103 —105	103 —105	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	91 — 93	90 — 92	90½	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations May 24th.	Closing Quotations May 31st:	Business done week ended May 31st, 1905.	
		‡	1903.	1903.	1904.			Highest	Lowest
£9,877	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	10 %	9¾ — 10½	9¾ — 10½	..	..
10,623	Do. do. 7 % Cum. Pref. ..	£	7 %	7 %	7 %	9¾ — 10⅝	9¾ — 10⅝	..	..
188,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	105 —108	108 —116 xd	107¼	..
80,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	7⅞ — 8¼	7⅞ — 8¼	7⅞	..
85,000	Do. do. do. 4½% Cum. Pref. ..	£	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	5 11/16	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..
40,000	Do. do. 1903	£	..	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	106 —108	106 —108	..	..
44,486	*Chelsea Electricity Supply, Ord.	£	4½%	5½%	6 %	6⅛ — 6⅝	6⅛ — 6⅝	6 7/32	6 1/32
150,000‡	Do. do. % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 —111	109 —111	110¼	110
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	6 %	10¼ — 11½	10¼ — 11½	11½	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	6 %	6 %	6 %	12¾ — 14¼	12¾ — 14¼	14¼	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	5 %	5 %	5 %	121 —128	124 —128	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	£	4½%	4½%	4½%	104 —106	104 —106	103⅞	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	4½%	8¾ — 9	8¾ — 9	..	..
80,000	Do. do. do. 6 % Pref., 40,001—80 ..	£	6 %	6 %	6 %	12 — 12½	12 — 12½	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	4½%	4½%	4½%	112 —115	113 —116	114⅜	..
950,000	Do. do. 4½% 2nd Deb. Stock	Stock	4½%	4½%	4½%	103 —105	103 —105	103⅞	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	5⅞ — 6¼	5⅞ — 6¼	5 25/32	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	..	6 — 6¼	6 — 6¼	6 3/32	..
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	4½%	4½%	4½%	107 —109	107 —109	..	..
91,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½	12 %	12 — 13	12 — 13	12 5/16	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£	Nil	Nil	3 %	2 — 2½	2 — 2½	..	..
61,000	Do. do. do. 6 % Pref.	£	6 %	6 %	6 %	5 — 5½	5 — 5½	5	..
371,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	4 %	4 %	4 %	99 —101	99 —101	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	7½	8½	10 %	9 — 9½	9⅛ — 9⅜	9 7/16	9⅛
76,121	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	4½%	4½%	4½%	5¼ — 5⅝	5¼ — 5⅝	5 9/32	5 17/32
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	4½%	4½%	4½%	109 —114	109 —114	..	..
950,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	3½%	3½%	3½%	97 — 99	97 — 99	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	99 —101	99 —101	100⅛	100
10,853	Notting Hill Electric Lighting	£	10 %	6 %	7 %	14½ — 15½	14½ — 15½	14⅝	..
59,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	14 — 15	14 — 15	14½	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	7 %	7%	7 %	8½ — 8¾	8½ — 8¾	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	3½%	3½%	3½%	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	4 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	£	1½%	3 %	4 %	3⅜ — 4⅛	3⅜ — 4⅛	3⅞	..
100,000	South Metropolitan Electric Light and Power (*Late Blackheath and Greenwich Dist. E.L.Co.*) Ord.	£	Nil	Nil	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..
50,000	South Metropolitan Electric Light and Power (*Late Blackheath and Greenwich Dist. E.L.Co.*) 7 % Pref.	£	Nil	7 %	7 %	13⅛ — 13⅝	13⅛ — 13⅝	..	..
100,000	South Metropolitan Electric Light and Power (*Late Blackheath and Greenwich Dist. E.L.Co.*) 4½% 1st Deb. Stock	100	4½%	4½%	4½%	105 —108	105 —108	..	..
80,000	Urban Electric Supply, Ord.	£	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	4½%	104 —106	104 —106	105	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	12 — 13	12 — 13	12⅞	12¾
28,151	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	6 — 6½	6 — 6½	6 5/8	..

Shares not officially quoted :—Mackay Companies, ord., 39¾—40¼. Pref. 74—74½.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, May 31st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	£2 dec.
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	8d.	..
a Potash, Caustic (75/80%)	per ton	£22	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	155/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
Sodium Bichromate, casks ..	per lb.	2¾d.	..
,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	¼d. dec.
c ,, Tube (brazed)	per lb.	9¼d.	¼d. dec.
c ,, ,, (solid drawn)	per lb.	8¼d.	¼d. dec.
c ,, Wire, basis	per lb.	7¾d.	¼d. dec.
c Copper Tubes (brazed)	per lb.	1¢½d.	¼d. dec.
c ,, ,, (solid drawn) ..	per lb.	10¼d.	¼d. dec.
g Copper Bars (best selected ..	per ton	£79	..

METALS, &c. (*continued*).		Latest Price.	Fortnight's Dec. or Inc.
g Copper Sheet	per ton	£79	..
g ,, Rod	per ton	£79	..
e ,, (Electrolytic) Bars ..	per ton	£70 10	..
e ,, Sheets ..	per ton	£87	..
e ,, Rod ..	per ton	£81	..
e ,, H.C. Wire	per lb.	9½d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
m German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/8½	..
i Iron, Charcoal Sheets	per ton	£15	..
i ,, Pig (Cleveland warrants)	per ton	45/9	9/1¼ dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£13 2 6 to £13 5	..
g ,, ,, Sheet	per ton	£14 15	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bott.	£7 7 6	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/8	..
p ,, rolled bars & rods	per lb.	1/1 to 1/8	..
p ,, ,, strip & sheet	per lb.	1/8	..
o Platinum	per oz.	82/6	..
e Silicium Bronze Wire	per lb.	10½d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£166 to £167	£1 inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/8	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£48 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£26 7 6	10/- dec.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Blue Aluminium Compounds Formed at the Aluminium Anode.—F. Fischer has recently made an examination of the substances which separate as layers upon the aluminium anode and exhibit a bluish colour. He has obtained the deposit by employing a tube of aluminium as anode instead of wire, so that it could be kept cool by a constant current of water. The deposit was of a bluish-green colour inside, tending to grey-green on the outside. Viewed under the microscope the material was seen not to be homogeneous, and by the aid of the polariscope it was ascertained to consist of a mixture of translucent colourless and deep blue particles. Analysis showed it to be a mixture of aluminium oxide and combined sulphuric acid, with a little silica, and just sufficient iron to be noticeable. Scales of metallic aluminium could not be detected, yet the innermost, blue-coloured portion of the material which was formed first liberated hydrogen when dissolved. Elementary sulphur could not be found, and it was not possible to separate the substance into a blue and a colourless portion. When heated, either after or during its formation, it became white in colour and was qualitatively identical with the material described by Norden. (*Zeits. anorg. Chem.*, 1905, xliii., 341). Norden's substance, it may be remembered, gave on analysis: Al_2O_3, 69·8 per cent.; SO_3, 13·2 per cent.; H_2O, 14·8 per cent.; and SiO_2, 2.2 per cent. It corresponded with a mixture of a compound $Al_2O(SO_4)_2\ H_2O + 5Al_2(OH)_6$ with 9·25 per cent. of metallic aluminium.

KEY ENGINEERING EXHIBITION.

One of the special features of this exhibition was the series of "reverse current" circuit breakers devised by Mr. Leonard Andrews. Many such devices are quite satisfactory so long as the normal pressure is maintained across the potential winding on the cut-out, and the current in the series winding is not excessive; but in the case of a heavy short across the brushes of a generator, the bus-bar pressure is liable to fall almost to zero, and an enormous reverse current will flow through the series winding, tending to entirely overpower the shunt winding, upon which the action of the reverse device is dependent.

To avoid this defect without the use of a polarised relay, the Key Engineering Co. has adopted the device of which a section is given herewith. This is an improvement on Mr. Andrews's original device, which was described in the Electrical Review of June 3rd, 1904. The series and shunt windings are so connected up that under normal conditions the fluxes flow through the field magnet limbs in series, avoiding the centre path. Should the current in the series winding be reversed, the fluxes oppose one another and traverse the centre path, producing a strong field across the air-gap, and lifting the movable core with ample force to trip the circuit-breaker.

In this construction it is possible to work with the core in the shunt winding highly saturated, and consequently if the pressure across the shunt-winding drops to something approaching zero, there is still sufficient magnetic force left to cause the device to operate satisfactorily on heavy reverse currents.

The characteristic curves, A and C, fig. 2, show the variations in the pull of the tripping core with different generating and motor currents; A with a normal pressure of 102 volts across the shunt winding, and C with a pressure of only 14 volts across this winding. It will be seen that even with a drop of potential of 85 per cent, the reverse current required to operate the cut-out is not materially greater than that with a normal potential.

An interesting feature of this device is that it may, with a slight alteration, be used as a combined excess-current and reverse-current device. It will be obvious that if the section of the core in the series winding is appreciably greater than that of the core in the shunt winding, the latter will become saturated before the former, and consequently some of the flux induced in the series core will leak back through the tripping plunger—thus, with a given excess current, causing this to lift and trip the circuit-breaker.

It is usually required, however, that a reverse current circuit-breaker shall not be tripped by any amount of forward current, and consequently, to ensure this, the core in the shunt winding

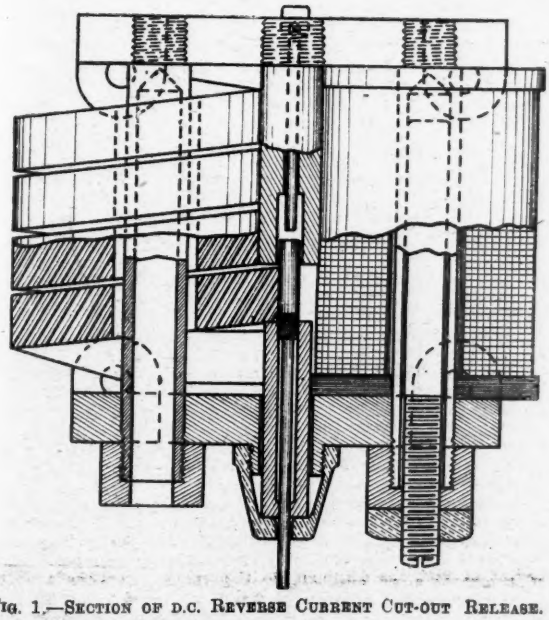


Fig. 1.—Section of d.c. Reverse Current Cut-out Release.

should be of heavier section than that in the series, in order that the latter may become saturated, and an easy path provided for any flux induced in the series core to return through the shunt core, thus entirely overcoming any tendency to magnetic leakage.

To enable the device to be used either as a reverse current-breaker only, or as a combined excess current and reverse, the respective cores in the shunt and series windings are made of hollow tubes, and a solid internal core is provided for fitting into either of the hollow cores.

Curves A and C, fig. 2, represent the characteristics of the release with the solid core inserted in the hollow core of the shunt winding. Under these conditions there is no pull on the tripping core with any amount of excess current.

Curve B (full line) shows the effect of removing the solid core from the shunt winding, and inserting it in the series winding. It will be seen that as a reverse-current device, the characteristic is not appreciably altered; that is to say, it takes approximately the same reverse current to trip it as with a core in the shunt winding. On the excess current side, however, the behaviour of the device is entirely altered. The magnetic current leakage, and consequently the pull on the core, increases with the generating current, and will, with a given excess current, trip the circuit-breaker. The slope of this curve may be adjusted as desired by varying the position of the core in the series winding.

One of the external attractions offered by the company to visitors attending its exhibition, was the opportunity afforded of inspecting the laying of a portion of the 34 miles of fibre conduit now

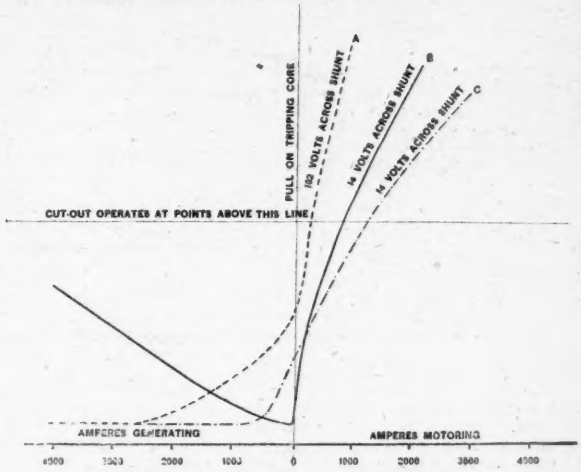


Fig. 2.—Performance of Reverse Current Device.

being installed by the Manchester Corporation. In the case of a 60-way 3-in. duct in Portland Street, the conduits were laid in a trench 3 ft. 4 in. wide and 9 ft. 6 in. deep. A bed of coarse concrete 4 in. thick was laid at the bottom of the trench, and topped with a covering of fine sand concrete. The conduits were arranged in 10 layers of six ways per layer. They were accurately spaced by means of comb-shaped wooden templates, placed at intervals along the trench, the space allowed between two ways being 1½ in. The space between the ways was filled with the fine sand concrete, and about an inch of this concrete was used between the respective layers. The conduit consists of tubes about 5 ft. long, the ends of each tube being tooled to make accurate socket and spigot joints; by this means perfect alignment and an absolutely watertight joint are secured. As a further precaution each joint is bound round with a piece of sticky tape about 1½ in. wide.

That no time has been lost in executing this work, and that the public are consequently put to the minimum of inconvenience, is evident from the following figures:—At 6.30 a.m. on Saturday, May 6th, the work of opening 65 yards of street was commenced, and by 9 a.m. the following Monday morning the whole work was completed, including the filling-in of the trench, and without any night-work.

The actual laying of the conduits was commenced at 6.30 on Sunday morning, and by 8.30 on Sunday evening the whole of the 65 yards of 60-way duct was completed. In this section 130 tons of concrete were used, and 3,900 yards of 3-in. duct.

This undoubtedly constitutes a very perfect example of conduit work, and it is interesting to note that the cost of the work was not greater than if a high-class earthenware conduit had been used.

INSTITUTION OF ELECTRICAL ENGINEERS

TELEPHONE TRAFFIC.

By Herbert Laws Webb.

(*Abstract of Paper read in London, May 11th, 1905.*)

I have always held that the study of the traffic is the most important part of a telephone man's work. Each connection consists of a certain number of operations, each operation involving a definite performance by apparatus and by a manipulator. Therefore, the principal aim of the telephone engineer should be to put the apparatus and the manipulators in a position to execute those various operations with the maximum accuracy and celerity. The efficiency of the individual connection requires efficiency in each step. It affects the whole engineering design of the system, and it affects both the capital charges and the working cost. Any gain, however slight, in the accuracy or the rapidity of manufacturing the individual telephone connection is felt throughout the whole system. It reduces the size of the plant in proportion to output and so reduces capital charges, and it reduces the amount of work done in proportion to output and so reduces working costs.

The gain of a fraction of a second on an operation many times repeated each day, has, in a large telephone system, a cash value running into handsome figures.

The importance of the study of telephone traffic, then, cannot be over-estimated. In the telephone system, even the humble wayleave officer or the storekeeper has his indirect share in the production of accurate and rapid operating.

The improvements in telephone exchange apparatus during the past 10 years have been revolutionary. The history of telephone exchange working may be roughly divided into two periods: one of about 16 years, in which the apparatus was mainly experimental, and many different systems were tried; and one of about eight years, in which there has been perfected and standardised apparatus, largely automatic in its working, capable of the greatest accuracy and rapidity in operation. In the old apparatus the percentage of error was very great, and the old apparatus was relatively slow in working.

In the standard apparatus of to-day, the use of lamp signals enables many things to be done which were impossible before. The prime advantages of lamp signals are that they are extremely compact, they have no working parts, and therefore may be placed in any position, vertical, horizontal, or at an angle; they are automatic in action or self-effacing, since the signal disappears immediately the current is cut off; and finally, they give a much more positive and assertive signal than any form of indicator.

The signals are placed immediately adjacent to the jacks or cords they control, which, in large switch-boards, is impossible with electro-magnetic indicators; the line lamp is immediately above or below its corresponding answering-jack, and the supervisory lamps are in line with the connecting cords and close to them. With this arrangement the operator loses no time and has to exert no brain-power in tracing the relation between the signal and its corresponding jack or cord. The lamp signal may be alight or out corresponding to the down and up positions of the indicator, but it may also flash, and it may be made to flash at different rates of speed, easily recognisable. Therefore the lamp signal is able to convey a greater number of meanings as a working signal, than an indicator. Finally, the more assertive and positive signal given by a lamp as compared with an indicator is due to a simple physical fact—the great sensitiveness of the eye to light. The lamp is seen out of the corner of the eye, so to speak, whereas an indicator must be more directly in the range of vision.

Perhaps the most striking improvement in operating, resulting from the use of lamp signals and the supply of energy from a central source, is automatic supervision. In the older systems of working the indefiniteness and unreliability of the signals made it necessary that the operator should give each connection a certain amount of supervision, which demanded a certain amount of the operator's time on each connection in excess of the time actually required for the operation of the connection. In the modern switch-board the exact condition of the two subscribers' lines connected, is shown by the state of the two supervisory lamps associated with the connecting cords. By the automatic working of these two signals, the operator knows when the called subscriber answers; she knows when one subscriber hangs up and the other does not; she knows if either subscriber wants her to come in on the line; and, finally, she knows when the two have hung up. The automatic supervision and the automatic and definite disconnection signal afforded by the double supervisory signals constitute an immense advance in the means of handling telephone traffic.

In the working of junction lines—a branch of the operating which is of the highest importance in large systems, since the greater proportion of the traffic passes over the junctions—great improvements have been effected by modern apparatus and methods. The use of lamp signals affords what was lacking before, a positive disconnection signal at the incoming end of the junction. The existence of the supervisory lamp on the cord at the answering position, enables the incoming junction operator to signal back automatically to the answering operator if the line wanted is engaged or out of order.

In the accompanying diagrams the average time occupied in the various steps of a connection between one direct line and another is shown for magneto working and for working with modern standard equipment.

The explanation of the diagrams is as follows:—

Zero being the starting-point at which the subscriber rings or takes his telephone off the hook, A is the point at which the operator has plugged in and answered, B the point at which she has taken and repeated the number, C the point at which she has tested the line wanted, plugged in and started to ring, and D the point at which the called subscriber answers. From D to E is the conversation, which is not shown on the diagrams, and F indicates the point at which the lines are disconnected after the end of the conversation at E. It will be seen that the total time spent in operating a local connection with magneto working was 14·77 seconds from the beginning of the call to the moment when the operator began to ring the called subscriber, and 17·1 seconds from the end of the conversation to the moment when the operator disconnected the two cords. In the diagrams relating to junction calls, the step B-C includes the time occupied by the answering operator in speaking by call-wire to the junction operator and getting from her assignment of a junction and in plugging into the junction, and the time occupied by the junction operator in testing the line called for, plugging in and starting to ring; during the step B-C on junction connections, work is being done simultaneously by the two operators at either end of the junction line.

The times given are the averages of many thousands of stop-watch observations made by trained observers with special signalling appliances attached to the lines under observation, and the figures indicate with great accuracy the actual average service received by the public. The service observed is that of New York City, where

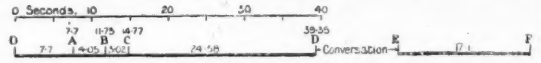


FIG. 1.—Progress of Local Connection, Magneto System.

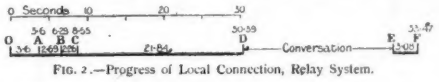


FIG. 2.—Progress of Local Connection, Relay System.

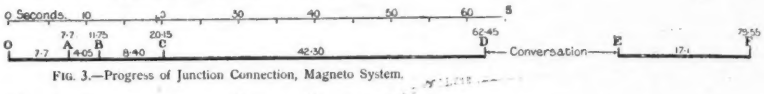


FIG. 3.—Progress of Junction Connection, Magneto System.

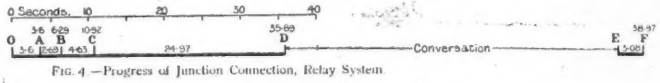


FIG. 4.—Progress of Junction Connection, Relay System.

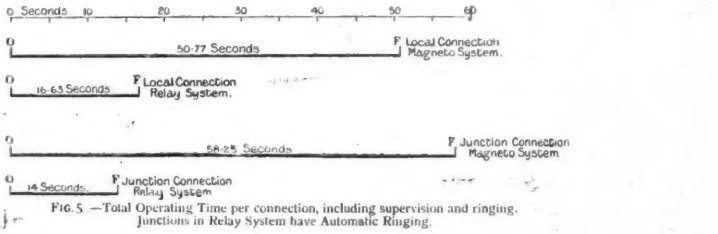

0 Seconds. 10 20 30 40 50 60
0 50·77 Seconds F Local Connection Magneto System.
0 16·63 Seconds F Local Connection Relay System.
0 58·25 Seconds F Junction Connection Magneto System
0 14 Seconds. F Junction Connection Relay System

FIG. 5.—Total Operating Time per connection, including supervision and ringing. Junctions in Relay System have Automatic Ringing.

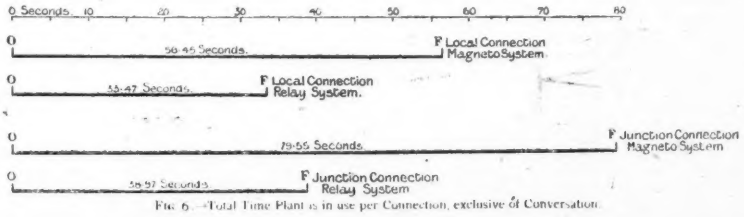

0 Seconds. 10 20 30 40 50 60 70 80
0 50·45 Seconds. F Local Connection Magneto System.
0 35·47 Seconds. F Local Connection Relay System.
0 79·55 Seconds F Junction Connection Magneto System
0 38·97 Seconds F Junction Connection Relay System

FIG. 6.—Total Time Plant is in use per Connection, exclusive of Conversation.

the working was at one time uniformly magneto, and is now and has been for the past three years uniformly relay, or common battery.

Taking the magneto service, the average time of disconnection, 17·1 seconds, seems long. The explanation is that on many occasion no disconnection signal was received by the operator, either because the subscribers failed to "ring-off," or because the signal failed to work. In such cases the operator would only learn that conversation had actually finished by supervision—listening-in. Similar conditions would be found on any magneto system to-day where the subscribers had not been rigorously trained to "ring-off."

A curious feature of the service with magneto working, is the much longer time taken to complete junction connections, and the diagrams show that the called subscriber's answer was apparently 18 seconds slower on junction than on local connections. As a matter of fact, the diagrams do the called subscriber a slight injustice; he really answers the call somewhat more quickly than the diagrams show. The explanation is that the operations on each connection are not strictly consecutive, as an operator usually deals with several connections at once.

The really striking features of the diagrams, however, are the great improvements in efficiency resulting from uniform relay working. It is seen that the local connection is operated in 8·55 seconds, as against 14·77 seconds, and the junction connection in 10·92 seconds, as against 20·15 seconds, while the delay in disconnection is reduced from 17·1 seconds to 3·08 seconds—a substantial and important gain due entirely to the use of double supervisory signals.

To show more clearly the gain in efficiency of operating with modern apparatus, I have plotted in figs. 5 and 6, the total time occupied in operating each class of connection under magneto and relay working, including supervision, and allowing 5 seconds for ringing, but eliminating the called subscriber's delay in answering, and, of course, the conversation. These diagrams show a very striking contrast between the results under old and modern methods. It is seen that the time spent in operating the average connection

with standard apparatus is just a third of the time occupied with magneto apparatus; in junction connections the gain is even greater, the time spent in operating the average connection with standard apparatus being less than a quarter the average time with magneto apparatus.

These figures indicate that, with the apparatus of to-day, the operator should be able to handle from three to four times the number of calls in a day that she was able to cope with 10 or 12 years ago.

It is impossible to establish exact comparisons of quantitative results to prove that the whole gain in efficiency and economy indicated by these diagrams has really been utilised. That a large part has is unquestionable. One instance that has come under my notice, illustrating a very substantial gain in economy, may be mentioned; it is an exchange which formerly contained a magneto equipment for 5,200 lines. The present switchboard equipment of standard apparatus is contained in a room of exactly the same size as the former room, and has a capacity of 9,600 lines.

A saving in time in operating the average connection results in a more economical use of the plant in two ways; first, as the operator can handle more traffic in a day, more lines can be terminated at a position, which means a shorter switchboard for a given number of lines, with many attendant economies; and second, as the plant is used for a less amount of time on each average connection, the daily traffic-carrying capacity of the plant is increased. In fig. 6 the diagrams illustrate the total time that the plant is employed in the unproductive part of the connection, the time that the plant is in use from the call to the second subscriber's answer, and from the end of the conversation to the disconnection. It will be seen that on the local connection the operating period on each connection has been reduced from 56·45 seconds to 33·47 seconds, a gain of 22·98 seconds, and from 79·55 to 38·97, a gain of 40·58 seconds on junction connections. Allowing an average of 120 seconds for the conversation, the result of shortening the time during which the plant is tied up on each connection by 40 seconds is an increase of 25 per cent. in the traffic-carrying capacity of the junction plant.

The great increase of efficiency shown by these diagrams is due not only to improved methods of signalling and improved apparatus generally, but also to more efficient operating and a more thorough study of the minutest details involved in the handling of telephone traffic. It remains true, however, that the improved apparatus is the fundamental cause of the increased efficiency, for with the standard apparatus of to-day we get absolute uniformity of working, and so are able to train operators more effectively and more systematically. In the old days, with a variety of types of equipment in use in the different exchanges, it was impracticable to establish a really effective training school. To-day, with uniform equipment in all exchanges, a training school where the embryo operator learns her work by the practical manipulation of the same appliances as she will handle in the regular exchange is a most natural institution. At such a training school more progress is made in a month in turning out an efficient operator than was formerly made in three months.

The general supervision of the service becomes much more effective with standard apparatus, because the lamp signals are much more easily observable by the supervisors than indicators are.

The constant observation of the traffic is the measure which has contributed most to the effective use of modern apparatus, and to the attainment of a high standard of efficiency and accuracy in the operation of a large daily volume of telephone traffic.

Some idea of the complexity of telephone traffic may be had from the fact that the form for recording these service observations contains 42 columns, each with its appropriate heading. The information gained by a large number of tests of this kind, in which observation is made of every detail in the brief history of the telephone connection, is of enormous value in bringing to light the weak spots in the service.

To secure speedy and accurate operation of the vast volume of traffic which flows daily through a large telephone system requires, first, that the apparatus used have signals of definite meaning, that the working of the apparatus be largely automatic, and that the apparatus be of uniform type throughout the system; second, that the operators be thoroughly trained in the manipulation of the apparatus and in the methods of dealing with all varieties of calls before being entrusted with the conduct of actual traffic; third, that the operators be continuously trained to active co-operation with each other, so as to produce general efficiency, and to accuracy and method in every detail; fourth, that a constant study be maintained of the actual conduct of the traffic, directed to the improvement of the standards of accuracy and speed.

Discussion.

Mr. J. Gavey, in opening the discussion, referred to the close relation between good design and capital expenditure in telephone installations. He emphasised the advantages of the automatic over the magneto board, pointing out that an operator on the former type of board could attend to double the number of subscribers, which meant a saving in first cost of plant, in floor space and in operators' wages. This applied even more to the junction working, which probably equalled 30 per cent. of the lines.

Mr. W. Cook argued that supervisory signals could have been attained without the use of signal lamps, and that the value of such a system depended on its ability to dispense with "listening in." In New York it had been found that with a magneto system the operator came into circuit on the average 5½ times, the time required for a local call being 14 seconds, and for a junction call 16 seconds; this disappeared with the introduction of the common battery system.

Mr. J. E. Kingsbury said that 5 million messages were telephoned daily in this country, and the method of conducting this traffic was a great factor in its success. Each system must be studied on its merits, but there were certain broad lines to go upon. Traffic affected all telephone plant but the lines. He agreed with the author that it was a great advantage to have the answering jack close to the indicator, but this was not new, and it had to be altered through mechanical reasons, facilitated by the introduction of the signal lamp.

Mr. S. J. Goddard commented on the similarity of telephone and railway traffic problems; he wished for further information about the former. There were four points of especial interest in regard to telephone traffic:—(1) The number of calls per subscriber; (2) the variation of traffic during the busy hours; (3) the sufficiency of the junction lines for their traffic; and (4) the operators' methods for obtaining efficient service. Inquiries over the line dislocated the traffic very much.

Mr. D. H. Kennedy contributed some interesting figures of the times of traffic operations. The operation denoted in the author's paper by O A was completed in 1 second by an expert operator. In the G.P.O. system a pilot lamp was provided for every 60 lines, and its withdrawal resulted in a slowing of the operations. Further particulars given, showed that a complete junction call occupied 7½ seconds, and necessitated 16 mental operations by four operators during that time. The paper was divided into periods, and he thought it might well have been divided up into a period of English development, and a later period of eight years during which Americans had brought the telephone to its present state; this was accounted for by competition in America, and monopoly in England.

Mr. Frank Gill found fault with the author, in that indirect signals had been in use for years. He thought that telephone traffic demonstrated that the ordinary method of fixed charges was all wrong; it led to much frivolous use of the lines which indirectly increased the amount of plant required, and its cost. The introduction of the flat rate in New York had led to a reduction in the number of lines engaged from 23 to 12½ per cent. He suggested a measured service, the user to pay for the time he used the telephone. In concluding, he mentioned some excellent time results of operations such as were given in the paper, these having been obtained in ordinary work at Nottingham and Hull respectively; at Nottingham the operation denoted by O A took 4·4 seconds, O D took 22 seconds, and E F took 4·7 seconds; at Hull the times were 4, 20·5 and 3·8 seconds respectively. He further showed by "time of answering" curves the average results obtained, which showed the efficiency gained by using the relay type of board.

Mr. H. Laws Webb briefly responded, remarking that the discussion which had taken place showed a general agreement with the conclusions of the paper.

THE ELECTRIC LIGHTING ACTS: REVISED BOARD OF TRADE REGULATIONS.

Last August we analysed the draft sets of regulations issued by the Board of Trade, comparing them with the old code and drawing special attention to the new proposals of importance. (See Electrical Review, Nos. 1,396-8). Since that date the Board of Trade has carefully considered the various criticisms and suggestions which have been received on the draft, and it has now issued the regulations in their final form. It is, perhaps, hardly necessary to say that a considerable amount of "boiling-down" has taken place, both in comparison with the old rules and those recently drafted. Without going through the new rules again *in toto* (for this we refer our readers to the issues mentioned) we propose pointing out where further alterations have been made. In one point the four sets of rules are similar; that is, they have the same number of clauses, and the reason will be apparent later on. From the critic's point of view, however, this considerably lightens the difficulty of comparison.

A.—Regulations for Securing the Safety of the Public.

Clause 1 (*b*) (2) now reads as follows, the added portion being italicised :—

> The supply to every arc lamp shall be controlled by means of an efficient cut-off switch, placed in such a position as to be easily handled by the person in charge of the arc lighting, and connected so that by its means all pressure can be cut off from the arc lamp itself, and from any regulating switch, resistance or other device in connection therewith. *Provided that where the arc lamps are connected in series across the outer conductors of a three-wire system, it shall be sufficient if one such switch be provided for each series of arc lamps.*

Clause 3 has been shortened, the conditions of extra high pressure supply to a factory or mine not being dependent on compliance with the Factory or Mines Regulation Acts, but with "such other regulation as the Board may prescribe."

Clause 4, originally as old Clause 5, now reads as follows :—

4. The sectional area of the conductor in any electric line laid or erected in any street after the date of these regulations shall not be less than that of a strand of seven wires, each of which is of No. 20 standard wire gauge, and the sectional area of every wire in a strand forming any such conductor shall not be less than that gauge. This regulation shall not apply in the case of an electric line placed in a lamp-post.

Clause 5 was old Clause 7, and this was modified in the draft. But the reservation that the testing pressure shall be 50 per cent. greater than the maximum, has been dropped, and the clause now stands :—

5. Every low pressure and medium pressure main shall be tested for insulation after having been placed in position, and before it is used for the purposes of supply, *the testing pressure being the maximum pressure to which it is intended to be subjected in use*, and in any case at least 200 volts, and the undertakers shall duly record the results of the tests of each main or section of a main.

The italicised portion shows what has been added to take the place of the above omission.

Old Clause 10, which was left intact, now figures as Clause 7, and specifies that "a high pressure circuit shall not be brought into use unless the insulation of every part thereof has withstood the continuous application during *half-an-hour*, &c.," the previous time being one hour.

We notice that old Clause 13, dealing with the amount of energy to be carried by a line used for high pressure, has been entirely dropped.

The question of overhead lines, which formerly took up so much space, and even in the draft rules was fairly lengthy for provincial undertakings, is now reduced to one clause common to all the codes, which runs as follows :—

13. Overhead lines shall not after the date of these regulations be erected or maintained, except in accordance with plans approved by the Board of Trade, and subject to such regulations as the Board may prescribe; provided that this regulation shall not apply to any electric lines which have been erected at the date of these regulations, so long as those lines are maintained in accordance with any regulations of the Board of Trade which are in force and applicable thereto at that date, and with any requirements of the Board made thereunder.

This certainly gives the Board of Trade more work to do, and the undertaker less to read, whilst the four codes are thereby equalised as regards the number of clauses.

The clause which in the old rules figured as No. 29, and in the draft remained intact, now has it :—"All metal conduits, pipes and casings containing any *high-pressure* electric line—." The italicised portion being added. After this there is a large break, but we find that the maximum power in case of underground sub-stations, &c., has been thrown together so as to include transformers in street boxes.

With regard to main fuses in service lines, it is now stated :—

But no fuse or automatic circuit-breaker shall be inserted in the intermediate conductor of a three-wire system where the pressure between the adjacent conductors exceeds 125 volts.

The remainder of part A is practically as drafted, but the sub-section of the clause dealing with connections of circuits with earth, now No. 34, and laying down that distributing mains must be divided into sections and interconnected through circuit-breakers, has been transferred to Section B.

B.—Regulations for Ensuring a Proper and Sufficient Supply of Electrical Energy.

The first thing we notice in this section is that old Clause 1, "notice of intention," has been omitted. As regards constant supply, the draft practically stands, but local authorities in the provinces are subject to Board of Trade control, and companies to agreement with the local authority. Companies in London have to agree with the local authority and the County Council, whilst local authorities have the County Council to deal with. As regards discontinuing the supply, or changing the polarity—

Notice to all persons likely to be affected shall be given of such discontinuance, or change, and of the probable duration thereof,

and the Board of Trade permission is dispensed with.

Clause 2 is the sub-clause (*b*) regarding connections of circuits to earth, which was dropped out of Sec. A, and has been inserted here. Clauses 3 and 4, dealing with declared pressure and frequency, have been somewhat modified from draft Clauses 4 and 5, and as they are important, we quote them in full for local authorities in London :—

3. Before commencing to give a supply of energy to any consumer, the undertakers shall declare to that consumer the constant pressure at which they propose to supply energy at his terminals. The pressure so declared shall be constantly maintained, subject to a variation not exceeding 4 per cent. under any conditions of supply which the consumer is entitled to receive, or such other variation as the Board of Trade may from time to time allow, and shall not be altered or departed from to an extent greater than that variation except by consent of the County Council, and upon such terms and conditions as the County Council may impose, and after public notice has been given during a period of one month, in such manner as the County Council may require, of the intention of the undertakers to apply for consent to alter the same. If the County Council refuse to consent to an alteration or impose any terms or conditions with which the undertakers are dissatisfied, the undertakers may appeal to the Board of Trade, whose decision shall be final.

Provided that any regulation in force at the date of these regulations whereby the consent of any consumer (or in default thereof the consent of the Board of Trade) was then required to a change in the declared constant pressure to that consumer's premises shall, notwithstanding anything in these regulations, continue of full force and effect in the case of any consumer whose consent was then so required, and shall apply in that case as if it had been expressly set out in these regulations.

4. Before commencing to give a supply of energy to any consumer, the undertakers shall declare to that consumer the system which they propose to adopt, whether alternating or continuous current, and, in the case of alternating current, the frequency—that is to say, the number of complete periods per second at which they propose to supply. The system and frequency so declared shall be maintained subject, as respects frequency, to a variation not exceeding 2½ per cent. from the declared frequency, and shall not be altered or departed from except by consent of the County Council, and upon such terms and conditions as the County Council may impose, and after public notice has been given during a period of one month, in such manner as the County Council may require, of the intention of the undertakers to apply for consent to alter the same. If the County Council refuse to consent to an alteration or impose any terms or conditions with which the undertakers are dissatisfied, the undertakers may appeal to the Board of Trade, whose decision shall be final.

Companies in the provinces have to obtain the consent of the local authorities, and it is added that "if the local authority refuse to consent to an alteration or impose any terms or conditions with which the undertakers are dissatisfied, the undertakers may appeal to the Board of Trade, whose decision shall be final." Local authorities in the provinces must obtain the consent of the Board of Trade, and companies in London are in the same position as local authorities.

The Penalty Clause remains as before. The following appendix makes it clear that there shall be no trifling with the Board of Trade :—

These regulations are made subject to the power of the Board of Trade to make such further or other regulations as they may think expedient; and nothing in these regulations shall be construed to authorise the undertakers to lay any electric line or work their undertaking otherwise than in accordance with the Order and the principal Act, or to supply energy otherwise than by a system for the time being approved of by the Board of Trade under the order.

Whilst the subjoined affords a little insight into departmental—shall we say, rivalry?

These regulations are, so far as they relate to factories and mines, in addition to and not in substitution for any regulations made by a Secretary of State under any Act relating to factories or mines.

ELECTRICITY ON STEAM RAILWAYS.

In the issue of May 12th of our contemporary, *The Transport and Railroad Gazette*, there is an interesting article by Mr. Clement F. Street on "The Use of Electricity on Steam Railways," in which he calls attention to a great many points which have frequently been emphasised in our columns in the past. His statement, that in the past, even in America, there has been a tendency for steam railways to look upon the proper handling of a suburban service as a necessary evil and a nuisance, and to consider that it is a hopeless task to make such a service pay is only too true, and even at the present day the directors of the S.E. and C.

Railway seem to hold similar views. But apparently in American railway circles different views are beginning to be held, and it is the general opinion there at the present time that suburban traffic, if properly handled, presents great possibilities as a source of revenue. It would seem that the same causes which are at work here, and which are making our railway companies seriously consider electric traction, have been at work in America, and have resulted in changing the view of American railways as regards suburban traffic. The electric tramway in England has developed very rapidly of recent years, and it is that which is blamed by most of our railways for the decrease in the receipts of their suburban lines, but it is probable that instead of being a cause of trouble and loss, the electric tramway will eventually turn out a blessing, by forcing railway companies into realising what a great source of profit is at present lying idle and not being utilised by them.

In America the same thing more or less has happened, the tramways having not only taken away all the local traffic from the railways, but at the same time created a very large new traffic which did not exist before the introduction of electric traction on tramways.

The striking success of the tramways has resulted in these lines becoming very congested, and consequently the average speed is very low. As far as the large towns are concerned, this average rarely exceeds 10 miles an hour, which means that the sphere of the tramway is limited to a radius of from four to five miles as far as an average maximum trip is concerned. It is not intended to imply that a tramway will not pay if it is very much longer than five miles, but that few people will be prepared to travel a greater distance than from four to five miles by tramway, if other facilities are provided. Those railways which, having lost the very short-distance traffic, began to electrify, with the hope, originally, of regaining the short-distance traffic which they had lost owing to the competition of the electric tramway, have not found their expectations realised, although the financial results have nearly always been most satisfactory. As a matter of fact, instead of the electrified railway damaging the tramway, it was usually found, on the contrary, that the traffic on the tramways increased at the same time as the railways found that the average run on their suburban lines was greatly increased. In other words, it was found that the electrification of railways induced people to live further out of town, and, therefore, to travel longer distances on the railways, utilising the tramways to get to business from railway termini in the town or to get home from the railway station in whatever suburb they resided.

It is only electrification which can be the salvation of railways as far as suburban traffic is concerned, because it enables them to double, if not treble, the average travelling speed of their trains, and not only to do this but greatly increase the frequency, thus practically doing away with time tables. At the same time the speed attainable on electric railways makes it impossible for the electric tramway to compete for a long distance, as it does at present with steam railways.

Mr. Street briefly summarises some of the benefits derived from electrified railways, as follows:—

Increase in gross receipts.
Better application of power to trains.
Increased capacity of termini.
Reduction in operating expenses.
Reduction of terminal expenses.
Reduction in cost and maintenance of equipments.
Increased reliability of service.

We have already many times in these columns called attention to these benefits, and they have recently been dwelt upon at length in the articles of Mr. Philip Dawson, consulting electrical engineer to the L.B. & S.C. Railway Co. (Elec. Rev., February and March, 1904). There are, however, some points raised by Mr. Street, which, even at the risk of repeating what we have already stated, are of such importance, and are so often entirely overlooked by some railway engineers, that we consider them again here.

As regards increase in gross receipts, the results of the Mersey Tunnel, the North-Eastern, and the Lancashire and Yorkshire Railways in this country have been so satisfactory, and are so well known, as not to require to be mentioned again here, not to speak of the phenomenal results obtained by the electrification of the Manhattan Elevated in America.

As regards the better application of power to trains, Mr. Street summarises his reasons for making this statement as follows:—

1. **A higher rate of acceleration can be obtained.**
2. **A change in the weight of a train does not cause a corresponding change in the rate of acceleration.**
3. **Rate of acceleration can be changed to suit different conditions.**
4. **Switch (shunting) engines are not required.**
5. **Draw-bar strains are distributed.**

As regards reduction in terminal costs, a few points are brought out by Mr. Street in his summary, which show how these reductions are brought about. Mr. Street states that with electric cars terminal costs are reduced by about 60 per cent., and the investments in buildings and equipment are reduced by from 80 per cent. to 90 per cent., and the following table is given, showing how this is accomplished:—

Roundhouse—Eliminated.
Cinder pit—Eliminated.
Washing boilers—Eliminated.
Cleaning flues and grates—Eliminated.
Packing glands—Eliminated.
Firing up engines—Eliminated.
Turntable expenses—Eliminated.
Wiping, practically—Eliminated.
Sand house expenses—About equal.
Water supply—Practically eliminated.
Coal trestles—Eliminated.

The arrangements made for handling coal and ashes are, of course, transferred to the central power house, but owing to the greater facilities available for this work, the cost of doing it can be reduced.

The care of electric cars does not necessitate expensive buildings, and, as a rule, they are not placed under cover when out of service. Where this practice is followed, the only building required is a small inspection house provided with pits. In fact, all the arrangements made for the care of locomotives are done away with, and the provision made for caring for cars under the present system, with the addition of an inspection and light repair house, will prove adequate.

Some remarks as regards reliability will certainly prove of great interest to our railway directors, as some of them have been heard to express grave doubts on this subject. According to Mr. Street, the records of the large elevated railway in America show only one-third as many delays to services, owing to failures of equipment, since electricity has superseded steam. It is stated also that these records refer only to the total number of delays, and do not take into consideration an increase of more than 20 per cent. in the number of trains operated, and the railway officials of this line state that they consider that the company has derived great benefit in this respect from the adoption of electricity.

Passing over many other advantages obtained and economies effected, the economy in coal consumption will be very considerable. Thus Mr. Stilwell stated, at the International Engineering Congress at St. Louis last year, that on the basis of horse-power actually delivered to a train, the fuel consumption for electricity was about one-third in quantity of that required when steam locomotives were in operation, and when it is remembered that, in London, at any rate, coal for locomotive purposes costs probably double what the fuel must cost which can be burnt in a large central station, if the cost of fuel is taken into consideration, Mr. Stilwell's statement shows that per horse-power-hour delivered to a train the cost of fuel for electric traction would amount to one-sixth the cost of fuel used by steam locomotives.

Mr. Street does not confine himself to giving the advantages of electric traction, but further considers the various systems which should be employed, and, after a most careful and exhaustive examination of all the different systems, gives his views unequivocally for the single-phase alternating current method, thus agreeing with the views which we have repeatedly expressed, and which are to the effect that, as far as the electrification of railways is concerned, the single-phase is the only possible system of the future.

We are glad to see an American railway authority like Mr. Street make such a clear statement in favour of the

single-phase system. The three-phase system has recently again come to the fore in some of the daily papers; but though we have acquired all the information we have been able to in connection with the results which have been obtained in actual practice on the Valtellina line, and which have appeared from time in our Italian contemporary, the *Elettricista*, the results of the investigation we have made have not been such as to convince us that our attitude as regards the system to be adopted for heavy traction on suburban railways is wrong.

We wish it to be clearly understood that no one can admire more than we do the splendid results obtained on the Valtellina Railway, and the excellent way in which Messrs. Ganz & Co. have so successfully operated this line. But this is a case where the line is a very long one and trains infrequent, there being probably fewer trains on the whole Valtellina system in one day than would be run on one of our London lines in one hour. Furthermore, the distance between stations is great, the line has severe gradients, and the question of acceleration is of little importance. In other words, the conditions to be fulfilled by electric traction on the Valtellina line are totally different to those which are absolutely essential to the success of electricity on a suburban system, conditions which are fulfilled both by continuous current motors and by single-phase motors.

The three-phase system requires two overhead wires, which must be insulated one from the other. In order to compensate for this disadvantage, there must be some advantage peculiar to the three-phase system, and the claim for such appears to rest entirely on the greater economy in energy consumption. This claim, however, can only be substantiated on the assumption that the energy returned to the line by the motors is actually used up in traction and really amounts to an important figure, because it must be borne in mind that three-phase motors even when operated in "cascade" have very large rheostatic losses, and that these must be made good by recuperation from another train; if this does not take place at the exact moment when it is required, it may become dangerous to the generating station.

Even if current can be returned to the line and used to any considerable extent, it is very questionable whether it will not cause trouble in the distribution system and generating station. In order to make current regeneration useful, the current must be absorbed by another train the moment it is generated, otherwise the regeneration will upset the equilibrium of the distribution, and as a first result will tend to accelerate the generators at the power station, which will then have a tendency to run as motors.

Under these circumstances it will at once become apparent that even if there is a net regeneration of from 10 to 20 per cent. of the energy consumed, it is highly improbable that all of this will be available for operating other trains, as other trains may not be in a position to take this current; and therefore, under these conditions, the amount of energy used per train-mile, that is to say, the amount of energy which would really have to be generated at the power station and paid for, would be very much greater than that which could be guaranteed inclusive of recuperation.

This point apparently is realised in Italy, and it has been proposed there to utilise the returned energy by means of heavy fly-wheels in the generating stations, or by hydraulic accumulators. But if energy is going to be purchased from outside, as appears very likely to be the case in the future, it is more than probable that the companies from whom such power may be purchased, will raise very strong objections to a system of traction which may have serious effects on the generating plant, unless the same be of very special design.

Mr. Celeri, one of the chief engineers of the Italian State Railways, under whose supervision the Valtellina line is, suggests in a signed letter in the *Elettricista* of January 15th of this year, that "although recuperation of energy is possible, when translated into actual figures, in actual practice, it comes to very little."

So far as regards returning energy to the line, we have now to examine what are the actual results claimed on experimental lines by Messrs. Novi and Donati, who recently carried out a series of extensive experiments on the Valtellina line, as compared with the results obtained by single-phase motors under somewhat similar conditions, and, fortunately, we are enabled to do so by means of figures which have been given by our contemporary *Engineering* in its last issue, in which it discusses electric traction on railways. The experiments of Messrs. Novi and Donati show that with electric locomotives hauling four or five carriages which together weigh between 60 and 70 tons, the locomotive itself weighing some 54 tons, the net energy used amounted to 50 watt-hours per ton-mile, the maximum speed reached being 37 miles per hour, and the run being on the level. We are not told what the average acceleration was, but, judging from what are the requirements on this line, the average acceleration during the whole period of acceleration would not exceed 9 in. per second per second. Some further experiments were made by Messrs. Novi and Donati to ascertain the amount of energy taken by a motor-car running by itself, and in this case it was found that it amounted to 77 watt-hours per ton-mile.

A train, composed of two motor coaches and one trailer, or of three motor coaches and two trailers, which is the usual train formation adopted on heavy rapid transit electric lines, would probably not consume as much as 77 watt-hours per ton-mile, provided no greater acceleration than 9 in. per second per second were required, but from the experiments of Messrs. Novi and Donati, a five-car train, comprising three motor coaches, and with a higher average speed and acceleration, should consume considerably more than 50 watt-hours consumed by a train hauled by special electric locomotives. Under these circumstances it is interesting to compare with the above data the figures given by *Engineering* as regards the actual watt-hour consumption on the single-phase railway which is now in regular operation at Spindlersfeld, and which has already been described in these columns. Here we have a train composed of two motor coaches and several trailer coaches, and although there is no recuperation of energy, the watt-hour consumption per ton-mile is stated to amount to only 56 watt-hours, and this with a very much more favourable rate of acceleration than is obtained in the case of the Valtellina line. Indeed, there is nothing to prevent the single-phase motor of the Eichberg type from being run recuperating, and in such a case, provided it were possible to use the recuperated energy, the energy consumption per ton-mile in the case of the Spindlersfeld line would be reduced to about 51 watt-hours per ton-mile. But here again we find the makers state that recuperation is not an advantage, and that they consider that better results will be obtained without it. In the case of the Spindlersfeld line we have a suburban service which is more or less comparable with English lines, and although this particular type of motor has the quality of being able to be worked recuperating, the manufacturers do not claim this as an advantage.

The real reason why so much appears to be made of recuperation by those who favour this method of control is the simple fact that were it not for recuperation of energy, the three-phase motor would be so wasteful, owing to rheostatic losses at starting, that it would be a hopeless task even to suggest its adoption.

We do not wish to be misunderstood as regards the position which we have taken up, which is simply that, for suburban traffic, such as is met with in and round our large towns, the single-phase system is the best for all requirements. As regards long-distance traffic, our views always have been, and still are, that for this country at least, electric traction is not likely, at any rate for a considerable time to come, to be seriously considered.

In countries where coal is expensive, or where water-power is plentiful, or on lines where there are heavy gradients, the conditions may be quite different, and there may be cases where the adoption of the three-phase system will prove of great advantage.

Electrolysis with Alternating Currents. — MM. Brochet and Petit have recently reported to the Académie des Sciences upon the electrolysis of formic and oxalic acids under the influence of an alternating current. They carried out their experiments in a cylindrical vessel of glass holding 150 cc., and used as electrodes two strips of platinum 11 cm. long × 0·4 cm. wide, the current density being 1 ampere per sq. cm. They found that electrolysis proceeded easily, the products being the same as with direct current, and the yield being very high.

THE SINGLE-PHASE RAILWAY SYSTEM IN ITALY.

By E. A. KERBAKER.

It is not uncommon in Italy to find towns of considerable importance which are lacking in facilities for intercommunication, on account of the mountainous nature of the country. In many instances the distance between a town and the nearest railway amounts to several miles, and generally there are gradients all along the route exceeding 1 in 10. Therefore traffic, even with carts, is laborious, and these places are in a very unfavourable position from an industrial standpoint.

Electric traction in some instances, and motor-car services in others, have effected great improvements, having made it possible to develop traffic which it had been impossible to carry on with steam.

Where the traffic is of moderate density and the route long, a motor-car service has proved the more advantageous; but when, with given local conditions, the traffic exceeds a certain limit, electrical traction is found to be the more economical. The success attained by the single-phase motor

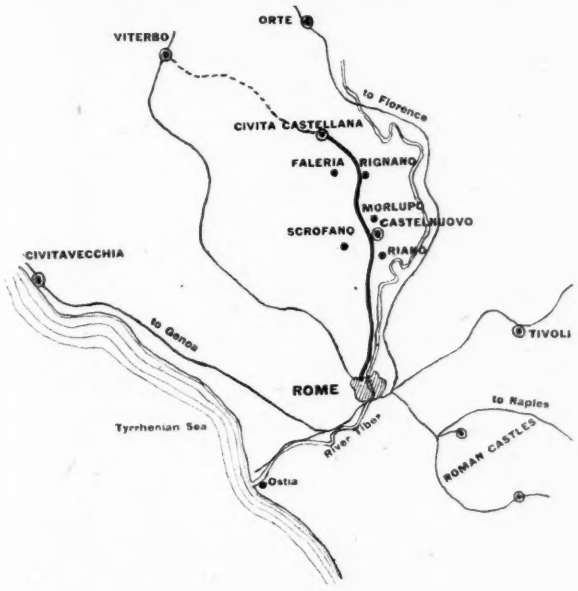


Fig. 1.

during the past year has constituted a great step in advance in the field of electric traction, because, thanks to the moderate capital outlay, it is possible to adopt electric traction on many lines which, on account of their great length, would require with direct current working a number of costly feeders, as well as sub-stations and attendants.

In the district between Rome and Civita Castellana there are about a dozen little towns which, so far, have had no means of communication with Rome. Fig. 1 shows the different railways going from Rome to various neighbouring places. All these railways are operated with steam engines, with the exception of a line going to the Roman Castles, which is approaching completion on the D.C. Thomson-Houston system, and another line, the Roma-Civita Castellana, the construction of which has already been commenced, and which will adopt the single-phase system of the Westinghouse Co. A description of the latter may be of interest, as it has been necessary to design for it many new details on account of the high voltage which has been chosen for the trolley wire.

This line, which will be ready in six months, is nearly 33·5 miles in length; the line, however, will eventually reach Viterbo, when its total length will be over 46 miles.

Fig. 2 shows the mountainous nature of the district. Many stiff gradients are met with, including one of 1 in 14 for about ½ mile.

The traffic on this line will be conducted as follows:—Between Rome and Ponte Milvio, an ordinary suburban service will be carried on with single cars weighing about 12 tons each when loaded; between Ponte Milvio and Civita Castellana, there will be two trains, each weighing about 20 tons fully loaded, and running at an average speed of nearly 15 miles per hour (maximum speed allowed, 22 miles per hour).

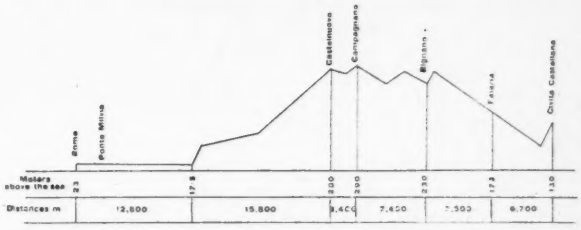


Fig. 2.

The power station will be at Ponte Milvio, 2·5 miles from Rome, and will be equipped with steam turbines of 300-H.P. driving single-phase alternators at 25 cycles and 6,000 volts. The line between Rome and Ponte Milvio will be operated at 550 volts, the remaining section at 6,000 volts.

The track, which is single throughout the line, has a gauge of 1 metre. The rails are of the Phœnix type, weighing 70 lb. per yard and 13 yards long, inside the town—say, between Rome and Ponte Milvio—for a length of nearly 2·5 miles. For the other part of the line—between Ponte Milvio and Civita Castellana—rails of the Vignoles type are used, 13 yards long and weighing nearly 42 lb. per yard. The track is laid down on the existing roadway (the old Via Flaminia), and the ties are of oak of the best quality, 33 in. apart.

Only one side of the track is bonded, with the exception of the part of the line between Rome and Ponte Milvio. The bonds are of the Chicago type, fixed under the fish-plates on the inner side. Each bond weighs about 0·35 lb., and the distance between the two terminals is 8 in. The bonding is done at the same time as the track is laid down, so as to ensure economy and efficiency.

Between Rome and Ponte Milvio, where a pressure of 550 volts is used, there are two No. 00 trolley wires of copper of high conductivity. From Ponte Milvio to Civita Castellana there will be used only one No. 0 trolley wire. The former are fixed in the ordinary way; the latter, which is of a special figure-8 section, is attached to mechanical ears made of steel. As shown in fig. 3, these ears are fixed to a steel wire, capable of resisting a tensile stress of 2,700 lb.

Double insulation is provided. The first is obtained by two special porcelain insulators, 5 in. high and 5 in. largest diameter; these insulators are fixed to the bracket arm by

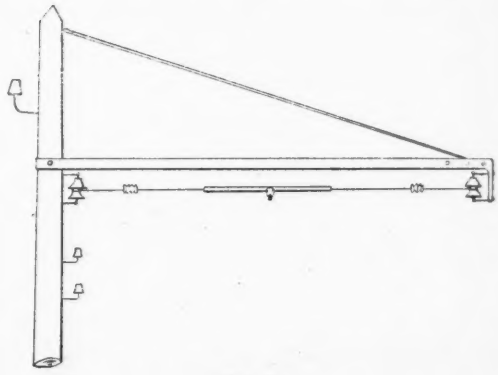


Fig. 3.

means of two bolts, and are tested before delivery, up to 20,000 volts. The second insulation consists of two insulators, to the ends of which are fixed with a special cement two hooks for the steel wire; these insulators, before delivery, are tested with 40,000 volts.

The bracket-arm is made of two flat iron bars, which are riveted together except at one end, where the bars are

forged in such a way as to surround the pole, and are fixed to it with a bolt and nut.

The poles are of chestnut; their sizes are:—Total length, from 28 ft. to 30 ft.; top diameter, 5½ in.; bottom diameter, 11 in. These poles are sunk in the ground to a depth of 5 ft. or 6 ft. On straight track they are about 125 ft. apart. Before erection, their lower ends are carbonised on the spot where they are to be erected.

As shown in fig. 3, on each pole, besides the bracket-arm, there are fixed three insulators. Two of them are for the telephone service, the third for the pilot wire. Since this pilot wire must work at a pressure of 6,000 volts, its insulators have to be of the best quality. The pilot wire referred to is of No. 13 S.W.G., and is required for the actuation of a safety device, which is fixed at the power station.

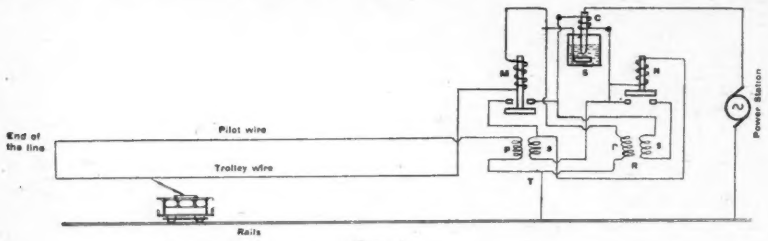


FIG. 4.

In order to render a pressure of 6,000 volts permissible on a public road, it is necessary to employ such a system that, should the trolley wire break down at any point of the line, the current will be cut off at the same moment at the power station.

Furthermore, the current must also be cut off in the case of a short circuit on the line, or of a current flowing in excess of the limits of safety.

Fig. 4 is a diagram showing the system adopted. The apparatus includes an automatic oil circuit-breaker S, with its coil C; two electro-magnets M and N; and two transformers T and R.

When the line is in its normal working condition, the current supplied to it goes through the electro-magnet M, but is not strong enough for operating the latter, which, therefore, remains always open. On the other hand, the transformers T and R have their primaries always connected on 6,000 volts, so that at the terminals of their secondaries there is a certain pressure. Furthermore, the secondary of T is always connected with the terminals of the electro-magnet N, and keeps its armature in the "open" position.

Suppose, first, that a short circuit happens on the line; then the electro-magnet M, which is in series with the trolley wire, carrying a current stronger than the normal value,

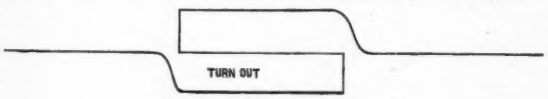


FIG. 5.

draws up the core and closes the circuit through the secondary of the transformer T and the coil C, thus opening the circuit breaker.

Suppose now that the trolley wire or the pilot wire breaks down at a certain point of the line. In this case, as the trolley wire and the pilot wire are in series, no current will go through the primary of the transformer T; therefore the pressure at the terminals of its secondary become zero, and no current can go through the coil of the electro-magnet N. The core of the latter comes down, closes the circuit through the coil C and the secondary of the transformer R, and consequently trips the circuit-breaker.

One of the difficulties of the system described is its application at the turn-outs, because if the two wires run in parallel, it is impossible to avoid danger, due to the breakage of one of them.

It has been proposed, however, to use the arrangement shown in fig. 5; by this means the safety of the system is maintained, but the construction of this part of the line requires much care and intelligent supervision.

The line in question will have no feeders at all, a No. 0 copper wire being sufficient for the whole length with the high pressure used; every three miles there will be placed section insulators which consist of a neutral wire fixed to two or more poles, to which are fixed also the two ends of the live trolley wire.

At the point, however, where the change of voltage has to be effected, the neutral wire has a length of about 40 yds., and there is a special switch which can connect this wire with one or other of the two voltages, but never both at the same time. This switch is erected just at the front of the power station, and one of the station attendants will be entrusted with its operation.

The lightning arresters for the line will be erected at the places where section insulators are fixed.

The total seating capacity of each car will be about 40 people; the cars will each have four wheels. Each car equipment includes two 40-H.P., 250-volt, 25-period, single-phase motors; one main transformer for primary pressures of 550 and 6,000 volts, and for a secondary pressure of approximately 250 volts; reversing switch; motor cut-out; air compressor; air reservoirs; complete Westinghouse brake equipment; and one bow-type trolley for high pressure, operated by compressed air.

The work of construction is now proceeding with great speed, and it is generally expected that a portion of the line will be ready for next August.

On the 26th of April the first stone of the power station was laid in the presence of several Italian Ministers and other authorities, the Belgian bankers, who have provided the capital, and some hundreds of people, who are anxiously awaiting the day of the inauguration of the system.

THE ROYAL SOCIETY CONVERSAZIONE.

THE first Royal Society conversazione of the season was held at Burlington House on 17th ult. A considerable number of highly interesting exhibits were on view; the physical department was unusually good, and though there was no epoch-making discovery demonstrated, the apparatus showed steady progress along many new lines.

The electric valve was very much in evidence, there being no fewer than three exhibits in which devices for allowing the electric current to pass in one direction only were utilised.

Sir Oliver Lodge lectured on the use of electric valves for the production of high tension continuous current. He mentioned that Sir George Stokes had suggested in a letter 20 years ago the use of electric vacuum valves for entrapping a portion of electricity by permitting its passage in one direction and stopping its return. In the apparatus shown by the lecturer, the electric valve was used in exactly the same way as a non-return hydraulic valve is used with a pump. In the electric apparatus, an induction coil played the part of the pump, and sent impulses of electric current through the electric valve into a condenser, which might be looked upon as playing the part of an air vessel or accumulator. It was interesting to see how the jar was gradually filled till the accumulated charge passed across a shunt air-gap of considerable length. The kind of electric valve used was a vacuum tube with a mercury electrode, resembling a Cooper-Hewitt lamp. Sir Oliver Lodge showed some interesting experiments to illustrate an ingenious theory of the action of these electric valves. If a funnel or cap is placed over a discharging positive electrode, it will be found that a spark discharge cannot be passed through the air-gap till after the lapse of some seconds. Sir Oliver's theory is, that the accumulation of free positive electrons in the funnel, bars the passage of the current. When these electrons have diffused away the current is free from obstruction, and passes with-

out difficulty. Gaugain's electric valve, and Holtz's funnel valve, which were invented some 50 years ago, will possibly now, for the first time, find their true explanation in terms of the modern electron theory.

Another application of the electric valve was shown by Prof. Fleming. The valve used by Fleming consisted of a bulb enclosing a carbon filament made like an incandescence lamp. The filament was surrounded by a metal cylinder, and the bulb was highly exhausted. It is well known that, in such an apparatus, when the filament is incandescent, negative electricity can move through the vacuum from the hot filament to the cylinder, but not in the reverse direction. Fleming has used this device to separate out the two opposite currents in an electric oscillation. It was used with a dead-beat galvanometer as a receiver in wireless telegraphy, showing a large deflection to one side, due to the electric waves. The valve replaces the coherer, and signals are given by long and short deflections of the galvanometer.

Prof. Fleming also exhibited an ingenious apparatus for measuring the length of the electric waves used in wireless telegraphy. This instrument is based on the fact that the length of an electric wave is proportional to $\sqrt{L\,C}$. It consists of a sliding tubular condenser and an inductance coil, so arranged that the capacity and inductance are varied together in the same proportion by one movement of the handle. The circuit is closed by a copper bar which is placed alongside of the aerial wire indicating the electric waves. The handle of the instrument is then moved until a Neon vacuum tube, used as an indicator, shines most brightly, and thus determines when the circuit is tuned to the frequency of the aerial. A pointer moving over a scale then indicates the wave length of the radiated wave in feet or metres. This instrument is named by its inventor the Cymometer, and it was described by him at a recent meeting of the Physical Society.* The tuning point is indicated with remarkable sharpness by the Neon tube.

Sir William Crookes exhibited specimens illustrating the action of light and radium upon glass. The radium appears to act on glass containing manganese in the same way as light, *i.e.*, both produce discoloration, but the radium produces as much effect in seconds as light does in years.

Mr. G. T. Beilby illustrated the phosphorescence caused by the β-rays of radium. Calc spar phosphoresces during exposure to the rays, and for a short time after their removal. There is evidently also a certain storage of phosphorescence, since it may be revived by heating the calc spar after the secondary phosphorescence has died down. Mr. Beilby's theory is, that the storage of phosphorescence and coloration effects are due to partial electrolysis of the calcium carbonate by the stream of negative electrons. A proportion of the ions combine at once, others continue to recombine after the rays have ceased to act, and the remainder only recombine when the mobility of the crystal molecules is increased by heat.

Messrs. Isenthal & Co. exhibited a resonance induction coil and high potential apparatus. Electrolytic condensers of very large capacity are charged from the mains through the primary of a suitably wound induction coil, the circuit being broken and reversed at zero potential by means of a motor-driven commutator of special construction. A powerful high tension discharge is obtained from the secondary of the coil. The apparatus has the advantage that no interrupter is required, though the motor-driven commutator appears to be a substitute of doubtful advantage.

Another arrangement for exciting an induction coil, or rather a high tension transformer direct from the alternating current mains, was exhibited by Mr. Russell Wright. The coil or transformer in this apparatus appeared to closely resemble Dr. Walter's transformer recently described in the Electrical Review, in which the great length of the secondary coil enabled alternating currents of commercial frequency to be used in the primary. As applied to excite Röntgen tubes in a stereoscopic apparatus, the discharge was rectified by point and plate electrodes which, as is well known, act as an electric valve.

Sir William Ramsay showed the action of actinium or emanium emanation on a sensitive screen. Actinium and emanium are different names for the same substance. It gives off an emanation whose period of activity is only a few seconds. When this emanation impinges on a sensitive zinc sulphide screen, the screen becomes luminous. The luminous patch can be *blown away*, and in a second or two reappears.

Mr. R. S. Hutton exhibited some new models of laboratory electric furnaces. The furnaces consist of a carbon tube, rod or plate, heated by an electric current. In the tube furnaces the carbon is surrounded by some material of low thermal conductivity, which also serves to protect the hot tube from oxidation. The substance to be heated is placed in a carbon boat or crucible inside the tube, and can thus be brought to a very high temperature. The method employed for conveying the current to the carbon by soldering water-jacketed sleeves to the electro-coppered ends of the carbon forms a novel feature of the construction. The rod and plate types of furnace are used for melting or heating up material placed around the carbon. Some samples of refractory oxides, fused in an electric furnace, were included in the exhibit. Tubes of fused quartz of considerable size were very striking.

Mr. W. Rosenhain's method of obtaining sections of metal for examination in the microscope was especially ingenious. The surfaces to be examined in section are first coated with a thick electrolytic deposit of copper, and a section is then cut through the compound specimen and is polished by a special means to avoid all surface erosion. The line of contact between the original metal and the electro-deposit is perfectly sharp under the highest magnification, and reveals an accurate sectional view of the original surface, the presence of the electro-deposit preventing the rounding and fraying of the edge, which would otherwise render such observation impossible. The section of the edge of a razor was shown in this way, and slip-bands and other microscopic features of metallic surfaces were shown.

* Electrical Review, April 7th, 1905.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

10,138. "An electrical apparatus for automatically-controlling the speed of motor-cars and like vehicles." G. H. C. Lumsden. May 15th.

10,146. "Improvements in electrical resistances." E. Rousseau. May 15th.

10,168. "Automatic device for the ignition of gas by electric currents." R. Keller. May 15th. (Complete.)

10,187. "Improvements in electric couplings." J. E. Bousfield. (Firm of J. Pintsch, Germany.) May 15th. (Complete.)

10,197. "Improvements in zinc rods for galvanic batteries of the Leclanché type." Siemens Bros & Co., Ltd., and G. W. Perry. May 15th. (Complete.)

10,202. "Improvements in or relating to methods of measuring, switching signalling and regulating electric current." M. Kallman. May [illegible] (Complete.)

10,210. "Improvements in direct-current dynamos and electric-motors." W. G. Schmidt. May 15th.

10,211. "Improvements in safety devices for use with bare suspended electric conductors." A. Green. May 15th.

10,214. "Improvements in electric current rectifiers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 15th. (Complete.)

10,215. "Improvements in vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 15th.

10,217. "Improvements in ropes and means for signalling or transmitting electricity through same." J. J. Condon and W. J. Reside. May 15th.

10,221. "Improvements relating to electric grinders for dynamos and the like." W. G. Potter. May 16th.

10,246. "Improvements in and relating to iron-free variable inductance coils." G. F. Mansbridge. May 16th.

10,258. "Improvements in service, junction and the like boxes for underground electrical conductors." A. Bruce. May 16th.

10,265. "Improvements in or relating to electrical switches." F. A. Griffin. May 16th.

10,288. "Improvements in or connected with holders for incandescent electric lamps." L. Sunderland and G. C. Pillinger. May 16th.

10,291. "Improvements in apparatus connected with the multiplication of electric force applicable to machinery of all kinds requiring power." T. J. Howell and E. J. Richardson. May 16th.

10,296. "An improvement in electrical fuse boxes." W. T. Henley's Telegraph Works Co., Ltd., and W. H. Nichols. May 16th.

10,298. "Improvements in electric switches or relays." A. Vera and L. G. Vera. (Date applied for under Patents Act, 1901, May 17th, 1904, being date of application in United States.). May 16th. (Complete.)

10,299. "Improvements in and relating to dynamo-electric machines." La Societe Boucherot & Cie. (Date applied for under Patents Act, 1901, May 17th, 1904, being date of application in France.) May 16th. (Complete.)

10,304. "Improvements in single-phase alternating current motors." Allmanna Svenska Elektriska Aktiebolaget. (Date applied for under Patents Act, 1901, September 15th, 1904, being date of application in Sweden.) May 16th. (Complete.)

10,315. "Improvements in resistances for electric circuits." H. Gibson, jun., and W. Bickerton. May 16th.

10,320. "Improvements in alternating electric current generators." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 16th.

10,321. "Improvements in electric circuit-breakers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 16th.

10,341. "An iron standard for fixing guard boards on electric railways." G. T. Trinder and T. D. Cramb. May 17th.

10,400. "Improvements relating to the application of fire alarm apparatus in connection with central battery telephone systems." I. B. Birnbaum and F. G. Bell. May 17th.

10,439. "Improvements in and relating to electrical governors for the control of gas engines used for the generation of electricity." H. E. Smith. May 18th.

10,446. "Improvements in or connected with the trolley poles of electric tramcars." J. S. Drousfield and C. J. J. Huntley. May 18th.

10,460. "Night-sights with electric incandescent lamps for artillery sighting or for any instrument in which night sighting may be required." G. A. Bertalot. (T. Bonino, Italy.) May 18th.

10,495. "Improvements in the methods of charging and discharging accumulators by automatic control." G. S. Ellis and A. M. Taylor. May 19th

10,509. "Improvements in coin freed electricity meters." J. M. Tourtel. May 19th.

10,553. "Improvements in electric arc lamps." W. S. Weedon. (Date applied for under Patents Act, 1901, May 20th, 1904, being date of application in United States.) May 19th. (Complete.)

10,554. "Improvements in and relating to electric motor-driven pumps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 19th.

10,555. "Improvements in alternating electric current generators." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 19th.

10,564. "Improved system of and apparatus for electric signalling." W. Johnson, A. Hotton and W. J. Berry. May 20th.

10,573. "Improvements in electrical leakage indicators." K. Edgcumbe. May 20th.

10,581. "Automatic switch for electric railways." V. Joksch, J. Petrik and R. Butta. May 20th. (Complete.)

10,584. "Improvements in or in connection with electric bells." T. B. Lowrance, J. R. Ryder and W. J. Lowrance. May 20th.

10,599. "Electro-magnetic ignition device for explosion engines." W. Roos. May 20th. (Complete.)

10,601. "Improvements in and connected with wireless telegraphy with earth currents." L. Zehnder. May 20th. (Date applied for under Patents Act, 1901, May 20th, 1904, being date of application in Germany.) (Complete.)

10,605. "Fraud detector for electric meters." W. W. Fuller. May 20th. (Date applied for under Patents Act, 1901, May 20th, 1904, being date of application in United States.) (Complete.)

10,610. "Improvements in switching devices applicable to electric flash advertising signs." L. K. Job. May 20th.

PUBLISHED SPECIFICATIONS.

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1903.

Secondary Batteries. A. Muller. 273. January 5th.

Railway Vehicles. Siemens Bros. & Co. (Siemens & Halske Actien Gesellschaft, Germany.) 718. January 12th.

Electricity Measuring. E. A. Carolan. (General Electric Co., U.S.A.) 1,067. January 16th.

Lifts. E. Chandoir and F. G. K. Caston. 2,060. January 28th.

Switches and Cut-outs. J. Hall. 2,284. January 30th.

Electrolysis. Mechwart, Coltri et Cie. (Date applied for under Patents Act, 1901, August 1st, 1902, being date of application in Italy.) 2,574. February 31st.

Switches. A. Watson. 2,429. February 2nd.

Lamps. G. W. Laybourne. 2,512. February 3rd.

Cables. G. F. Mansbridge. 2,963. February 7th.

Electricity Measuring. W. E. Groves. 3,572. February 16th.

Rail cleaners. A. T. M. Mather. 3,700. February 17th.

Alternating Current "Machines." O. S Bragstad and J. E. La Cour. (Date applied for under Patents Act, 1901, April 29th, 1902, being date of application in Norway.) 3,704. February 17th.

Points for Overhead Conductors. A. E, Burton and J. E. Leach. 3,709. February 17th.

Magnetic Clutches E. R. Douglas. 3,737. February 17th.

Switches and Cut-outs. H. P. Ball. 3,837. February 18th.

Fuse and Terminal Boxes. L. W. Crosta. 4,056. February 20th.

Thermostats. G. E. Wright and G. E. McNeill. 4,126. February 21st.

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Switches and Cut-outs. Mechwart, Coltri and Co. (Date applied for under Patents Act 1901, August 29th, 1902, being date of application in Italy). 4,727. February 28th.

Conduits for Cables. O. Wilhelmi. 4,944. March 3rd.

Telegraphs. C. Méray-Horváth. 4,972. March 3rd.

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Dynamos. E. A. Carolan. (General Electric Co., U.S.A.) 5,291. March 6th.

Railways and Tramways. E. S. Karslake. 5,913. March 14th.

Ignition Apparatus for Motor Cars. W. W. G. Webb. 6,140. March 17th.

Storage Batteries. W. Feune and W. P. Perry. 6,145. March 17th.

Railways Electric. E. A. Carolan. (General Electric Co., U.S.A.) 7,140. March 27th.

Switches and Cut-outs. S. Whipp. 7,241. March 28th.

Telephone Systems: Telegraphs. C. Turchi and E. Brune. 7,585. April 1st.

Trolleys for Electric Tramcars. J. Aldworth. 7,625. April 2nd.

Trolleys for Electric Tramcars. S. Hindley. 7,689. April 2nd.

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Telephone Systems. T. Paul and J. L. McDougall. 7,789. April 3rd.

Electrodes of Arc Lamps. R. Hopfelt. 7,881. April 14th.

Induction Motors. A. L. Cushman. 8,018. April 7th.

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Multiplex Telegraphy. S. D. Field. 4,176. February 19th.

Electrical Measuring and Indicating Instruments. G. K. B. Elphinstone. 4,284. February 19th.

Electricity Meters. J. M. Tourtel and the Tourtel Manufacturing Co., Ltd. 4,376. February 22nd.

Controlling Incandescence Electric Lamps. R. F. Ferguson. 4,896. February 22nd.

Electric Switch. G. Smith. 4,587. February 24th.

Rupturing Electric Circuits. P. H. Thomas. (Date claimed for patent under Patents Act, 1901, June 27th, 1903, being date of application in United States.) 4,663. February 25th.

Rupturing Electric Circuits. P. H. Thomas. (Date claimed for patent under Patents Act, 1901, June 27th, 1903, being date of application in United States.) 4,666A. February 25th.

Controlling Alternating Current Electric Motor. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 4,771. February 26th.

Controlling Alternating Current Motors. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 4,772. February 26th.

Controlling Alternating Current Motors. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 4,773. February 26th.

Trolley Poles for Cars Electrically-propelled on the Overhead System. W. H. Kilbourn and A. D. Flower. 4,874. February 27th.

Wireless Telegraphy. G. Marconi. (Date claimed for patent under Patents Act, 1901, October 18th, 1903, being date of application in United States.) 4,869. February 27th.

Automatically Interrupting Electric Current. Aktiebolaget Svenska Elektriska Urfabriken. (Date claimed for patent under Patents Act, 1901, March 3rd, 1903, being date of application in Sweden.) 4,953. February 29th.

Electrical Radiators. H. J. Dowsing. 5,119. March 1st.

Dynamos and Electric Motors Preventing or Lessening Sparking at the Brushes. W. Armistead. 5,146. March 2nd.

Electric Fuses and Fuse Boxes. J. L. Davies. 5,298. March 3rd.

Electrostatic Wattmeters or Watt-hour Meters. E. Wilson. 5,582. March 7th.

Annunciators for Electric Bells and the like. H. Henning. 5,663. March 8th.

Electrical Regulating Devices Applicable to Clocks. F. W. Howorth. (Actien Gesellschaft "Magneta" Electrische Uhren ohne Batterie und ohne Contacte, Switzerland.) 5,731. March 8th.

Electric Insulating Compositions. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 6,402. March 16th.

Electrical Candle Fittings. O. T. Banks. 6,425. March 16th.

Elastic Insulating Clutches for Electric Dynamos and Motors. H. H. Lake. (L. Risso, Italy.) 6,429. March 16th.

Electric Switches. The London Electric Supply Corporation, Ltd., and G. W. Partridge. 6,433. March 16th.

Saddle for Carrying Electric Cables. R. C. Sharp. 6,525. March 18th.

Manufacture of Cement for use in Electric Lamps and for other purposes. Cleminson Electric Lamp Attachment, Ltd., and W. King. 6,600. March 18th.

Drum Supports for Electric Lamp and other Wires. G. Ackermann and Engisch. (Date claimed for patent under Patents Act, 1901, March 28th, 1903, being date of application in Switzerland.) 6,612. March 18th.

Sparking Plugs and the like. H. Smith and E. W. Lewis. 6,682. March 19th.

Electric Switches. H. J. Gore. 6,718. March 19th.

Electrical Switching Apparatus. J. R. Dick. 6,857. March 21st.

Mercury Electric Current Interrupters. H. I. W. Schwedler. 13,379. June 13th.

Electric Cables. C. J. Beaver and E. A. Claremont. 13,382. June 13th.

Control of Continuous Current Electric Motors for Use in Electric Traction. A. Méaroz. (Date claimed for patent under Patents Act, 1901, June 4th, 1903, being date of application in Switzerland). 12,643. June 3rd.

Generating Electricity by the Use of Moist Chemicals which are Mechanically Pressed upon Zinc. H. Nehmer. 4,512. February 23rd.

Transmitters for Wireless Telegraphy. Marconi's Wireless Telegraph Co., Ltd., and A. Gray. 5,113. March 1st.

Switches for Igniting Circuits of Multiple Cylinder Explosion Motors. E. Talbot and D. Mondey. 5,147. March 2nd.

Contact Devices such as Resonance Relays for Telephone Systems. P. C. Pedersen. 5,308. March 3rd.

Base or Wall Block to Facilitate the Erection of Electric Light Fixtures and Provide better Insulation at their Bases. J. W. Ewart. 5,661. March 8th.

Safety Devices for Electric Railways. G. Gibbs. 8,444. April 12th.

Electrically Propelled Vehicles. La Société Anonyme L'Electrique. (Date claimed for patent under Patents Act, 1901, January 14th, 1904, being date application in France.) 8,986. April 19th.

Alternating Current Meters of Ferrari's Principle. E. Morck. 9,307. April 22nd.

Electric Burglar and Fire Alarms. H. Birbeck. (S. Schwartzchild, W. S. Dodd and J. C. Johnson, United States.) 9,310. April 22nd.

Charging Storage Batteries without the aid of Auxiliary or Special Apparatus. C. Kraft. 9,815. April 29th.

Driving Mechanism for Electrically Propelled Vehicles. C. de Kandó. 9,951. April 30th.

Safety Device for Electric Lifts. W. Sprowson. 9,954. April 30th.

Heating Liquids by Means of Electrical Current. E. R. Waterman 10,189. May 3rd.

Time Switches for Controlling Railway Barriers and the like. F. Neugebauer. 10,391. May 5th.

Automatic Trolley Controlling Devices for Electric Tramcars and the like. H. W. Nichols. 10,623. May 9th.

Sparking or Igniting Devices for Combustion Engines. W. P. Thompson. (A. C. Stewart, United States.) 10,811. May 10th.

Telephone and Telegraph Systems. G. Ritter. 12,187. May 28th.

Speed Control of High-Pressure Electric Motors. A. J. Boult (C. de Kandó. Hungary.) 12,332. May 31st.

Producing Reactions in Gases by Means of Electricity. J. Y. Johnson. 5,688. March 8th.

Lamp Holder. H. Hirst and J. H. Collings. 5,860. March 10th.

Spark Arresting Apparatus. J. Holden and E. S. Tiddeman. 6,642, March 18th.

Preliminary Treatment for Electric Accumulator Plates. H. Leitner. 6,792. March 21st.

Apparatus or Appliances for the Manufacture of Conduits for Electric Cables. J. H. Sutton and L. Gregson. 6,806. March 21st.

Controlling Electrically Operated Elevators. H. E. Klein. 7,021. March 23rd.

X-Ray Apparatus. G. E. Gaiffe. 7,489. March 29th.

Cluster Sockets for Electric Lamps. W. Fairweather. (The Benjamin Electric Manufacturing Co., U.S.) 7,824. April 5th.

Twin Sockets for Electric Lamps. W. Fairweather. (The Benjamin Electric Manufacturing Co., U.S.) 7,825. April 5th.

Producing Metal Matrices for Making Electrotype Printing Plates. E. Albert. 8,117. April 8th.